# GSFC PREFERRED PARTS LIST
# PPL-15

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## GODDARD SPACE FLIGHT CENTER

This document was prepared by the Product Assurance Division of the Goddard Space Flight Center and the Preferred Parts Mission of the Sperry Support Services Facility, Sperry Corp.

Edited & Approved by: _____

John W. Adolphsen
Parts Branch

Approved by: _____

Perry R. Mason, Jr., Head
Parts Branch

October, 1980

To: Holders of GSFC Preferred Parts List

From: John W. Adolphsen, Head, Preferred Parts Staff, Parts Branch, PAD

Subject: Issuance of GSFC Preferred Parts List No. 15

GSFC Preferred Parts List PPL-15 of October, 1980 supersedes PPL-14, which should now be discarded.

John W. Adolphsen

# PREFACE

## PURPOSE

This document contains a listing of preferred parts, part upgrading procedures, part derating guidelines, and part screening procedures to be used in the selection, procurement, and application of of parts for GSFC space systems and ground support equipment.

## AUTHORITY

The GSFC PPL is authorized and invoked by Goddard Management Instructions (GMI) 5330.6, *Implementation of the Goddard Space Flight Center Parts Program.*

## STANDARDIZATION

MIL-STD-975, the NASA Standard (EEE) Parts List (SPL), is the prime reference document for preferred electronic parts for NASA. The GSFC Preferred Parts List (PPL-15) complements MIL-STD-975 by listing additional device types and part categories not included in MIL-STD-975. All parts or styles listed in MIL-STD-975C are identified in PPL-15.

## QUALITY LEVELS

Consistent with MIL-STD-975, PPL-15 specifies two levels of quality, and these levels are defined essentially in the same manner. Grade 1 parts are intended for critical flight and mission-essential ground support applications where failure would cause major mission degradation and part performance is critical to mission success or safety. Grade 2 parts are for non-critical flight and non-mission-essential ground support applications. In some cases, a SPL Grade 2 part has been listed as a Grade 1 level part in the PPL. Where any conflicts exist between the SPL and PPL-15, PPL-15 takes precedence.

The parts listed in this document meet the requirements of a Military or NASA Center Specification. When a PPL listed part is purchased by GSFC, the specification listed for the part and the recommended manufacturer(s) or the manufacturers on the QPL for the part must be referenced in the procurement request.

All specifications listed in the PPL are maintained on file in the Parts Branch for reference purposes. GSFC personnel can obtain copies of specifications through their division offices from the Product Assurance Library, code 311A, telephone (301) 344-7240. Contractors, approved domestic and foreign experimenters, and international cooperative project working groups can obtain copies of the PPL and copies of referenced documents, except MIL specifications, by a written request via the cognizant project office. All others may obtain copies of the PPL through the National Technical Information Service (NTIS), Springfield, VA 22161.

## REVISIONS

The PPL will be reissued during 1982. Portions may be changed and updated prior to that date, as required. Parts not now listed, for which a substantial or critical usage is anticipated, should be brought to the attention of the Preferred Parts Staff so that those parts may be considered as candidates for evaluation and possible future listing in the NASA SPL or the GSFC PPL. Call (301) 344-8896 or (301) 344-8830 or (301) 344-6633.

## PART CHARACTERISTICS

Electrical characteristics are specified at 25°C ambient, unless otherwise noted.

## CRITERIA FOR LISTING PARTS

Parts are listed in the PPL based on the following criteria:

(1) they can be procured to a high reliability military or NASA specification;

(2) they have complied with an approved series of qualifying criteria;

(3) they are judged by the GSFC Parts Branch to be available and not redundant to other parts in the GSFC PPL or NASA SPL.

## USER RESPONSIBILITY

GMI 5330.6, Implementation of the Goddard Space Flight Center Parts Program, should be reviewed by all those required to use the GSFC PPL. This means that:

(a) In designing new systems, users shall use the SPL and PPL as the prime reference sources to select part types known to be more reliable than others.

(b) The part should be purchased to the specifications referenced in the SPL or PPL.

(c) Users should consult their project parts engineer for information concerning the detailed requirements on the information that must be included in or accompany a Non-Standard Parts Approval Request.

The SPL and PPL serve the Center as a whole covering both Flight and Ground Support Equipment applications and needs. It is the responsibility of the user, the product assurance engineer, and flight assurance manager to insure that the proper grade level parts are selected from the SPL and PPL commensurate with the criticality assigned to each project or system.

## RELIABILITY NOTES

### Screening

Improvement in the reliability of electronic parts can be realized through screening. This is demonstrated by most ER (Established Reliability) and TXV (Testing Extra, Visual Pre-cap

Inspection) specification programs of the military, which are specified in the SPL and PPL wherever appropriate. The TXV specifications cover semiconductors and upgrade existing MIL devices by adding a 100% burn-in as part of the screening procedure and requiring that a visual inspection be performed prior to the lidding of the device. The ER specifications similarly cover a variety of components such as resistors and capacitors, and additionally define various failure rate qualification levels. Screening of non-TXV/ER parts to prepare them for flight use is required (see Appendix C). However, preference must be given to the listed TXV/ER parts before considering the use of the equivalent JAN part which is subsequently screened, inasmuch as more protective screens, such as pre-cap visual inspection, often can be added, as part of the total manufacturing process, than can be prescribed in Appendix C. TXV devices must be rescreened in accordance with the applicable TX detail specification, because of semiconductor quality problems.

## ESTABLISHED RELIABILITY

The SPL and PPL, wherever feasible, list capacitors, inductors, relays, and resistors procurable to military "Established Reliability" (ER) specifications. These specifications provide known levels of reliability (failure rates) which have been demonstrated under controlled test conditions, as specified in the military specifications, and expressed as percent failures per thousand hours (%/1000 hours). The failure rates are established at rated stress conditions and at 60 to 90% confidence levels, depending upon the particular part and military specifications.

## COMPONENT QUALITY and MIL-HDBK-217C

MIL-HDBK-217C, *Reliability Prediction of Electronic Equipment,* gives various equations and tables to calculate the failure rate of a component in a system. The general form of the failure rate equation is:

$$\lambda_p = \lambda_b(\pi_E \times \pi_Q \times \Pi)$$

where

$\lambda_p$ = Part failure rate (Failures/$10^6$ hours)

$\lambda_b$ = Base failure rate - relating the influence of electrical and temperature stresses on the part.

$\pi_E$ = System Environment Factor

$\pi_Q$ = Quality Factor

$\Pi$ = Product of other factors unique to each device type.

$\pi_E$ is based on the application of a part, whether flight or ground equipment. $\pi_Q$ is based on the quality of the purchased part. These factors appear in the reliability models for all component types. The following tables list representative quality factors for the quality levels of components procured for GSFC projects.

MONOLITHIC MICROCIRCUITS

| QUALITY LEVEL DESIGNATION | QUALITY FACTOR, $\pi_Q$ |
|---|---|
| MIL–M–38510, Class S | 1 |
| MIL–M–38510, Class B | 2 |
| MIL–STD–883, Method 5004, Class B | 5 |
| Vendor Version of 5004 | 10 |
| MIL–M–38510, Class C | 16 |
| Commercial Hermetic Package | 150 |
| Commercial Plastic Package | 300 |

DIODES/TRANSISTORS

| QUALITY LEVEL DESIGNATION | QUALITY FACTOR, $\pi_Q$ |
|---|---|
| JANTXV | 0.12 |
| JANTX | 0.24 |
| JAN | 1.2 |
| Commercial Hermetic Package | 6.0 |
| Commercial Plastic Package | 12.0 |

"ER" PASSIVE COMPONENTS

| QUALITY LEVEL DESIGNATION | FAILURE RATE LEVEL (%/1000 hrs.) | QUALITY FACTOR, $\pi_Q$ |
|---|---|---|
| M M | 1.0 | 1.0 |
| P | 0.1 | 0.3 |
| R | 0.01 | 0.1 |
| S | 0.001 | 0.03 |

Although the Failure Rate Levels for "ER" parts differ by factors of 10, MIL–HDBK–217C states that field data shows the true failure rates to vary by a factor of 3 and the Quality Factors have been adjusted to reflect this fact.

## PART DERATING

Conservative application stresses are an important design tool for decreasing part degradation and improving failure rates, and prolonging the useful life of parts. For guidance, recommended part derating factors are tabulated in Appendix B.

## PART UPGRADING

For some types of devices listed in the SPL and PPL, the listed Grade 1 devices are not available. Appendix A gives guidelines for upgrading Grade 2 devices to an acceptable level for use as a substitute for the missing Grade 1 device. In all cases, upgrading must be approved by the Project Parts engineer.

## PARTS INFORMATION DIRECTORY

Assistance in the selection of parts, parts specifications, manufacturers surveys, incoming inspection, screening evaluation tests and failure analysis services for all parts are available from the Parts Branch of the Product Assurance Division.

For assistance on electronic parts problems and questions in direct support of specific projects, users should contact the cognizant parts specialist assigned to the respective project. If unknown, the identity can be determined by contacting the project office.

For general evaluation information of electronic parts, part specifications, and part qualification, users may contact a specialist in the particular part category, as listed below:

| PART CATEGORY | SPECIALIST | TELEPHONE (301) 344– |
|---|---|---|
| Capacitors | P. Jones | 5910 |
| Connectors | J. Lawrence | 5640 |
| Crystals | N. Tyson | 7113 |
| Diodes | M. Robertson | 6165 |
| Filters | P. Jones | 5910 |
| Fuses | L. Buyer | 5910 |
| Inductors | L. Buyer | 5910 |
| Microcircuits | M. Baluck | 5987 |
| PC Boards | H. Chernikoff | 5984 |
| Relays | J. Lawrence | 5640 |
| Resistors | L. Buyer | 5910 |
| Solder | H. Chernikoff | 5984 |
| Thermistors | L. Buyer | 5910 |
| Transformers | L. Buyer | 5910 |
| Transistors | M. Robertson | 6165 |
| Wire and Cable | J. Lawrence | 5640 |
| All | Preferred Parts Staff, Sperry Support Services | 6633<br>8830 |

Additional services in support of the GSFC parts program are:

| FUNCTION | CONTACT | TELEPHONE (301) 344– |
|---|---|---|
| Electronic Parts Qualification Testing, Maintenance of the PPL | J. Adolphsen | 8896 |
| Electronic Parts Incoming Test, Inspection, and Screening | N. Tyson | 7113 |
| Data Systems | G. Ritter | 7113 |
| Failure Analysis | N. Tyson | 7113 |
| Quality Surveys<br>Procurement Request Review | Cognizant Office of Flight Assurance Representative | 7669 |
| Packaging Process Specialist | H. Chernikoff | 5984 |

## CONTENTS

## CONTENTS (cont.)

## Index of Preferred Capacitors

| Military Style | Description | Control Specification | Refer To |
|---|---|---|---|
| CCR | Ceramic, Temperature-compensating, Fixed | MIL-C-20 | MIL-STD-975 |
| CDR | Ceramic, Chip, Multiple-layered, Fixed | MIL-C-55681 | |
| | Styles CDR01, 02, 03 | | Pages 01-2, 01-3 |
| | Styles CDR04, 05, 06 | | MIL-STD-975 |
| CKR | Ceramic, Fixed | MIL-C-39014 | MIL-STD-975 |
| CLR | Tantalum (non-solid) electrolytic, Fixed | MIL-C-39006 | MIL-STD-975 |
| CRH | Plastic (metalized), Fixed | MIL-C-83421 | MIL-STD-975 |
| CSR | Tantalum (solid) electrolytic, Fixed | MIL-C-39003 | MIL-STD-975 |
| CYR | Glass, Fixed | MIL-C-23269 | |
| | Styles CYR10, 15, 20, 30 | | MIL-STD-975 |
| | Styles CYR13, 41, 42, 43, 51, 52, 53 | | Pages 01-4 to 01-12 |

NOTES:

1. For part styles listed in MIL-STD-975, GSFC makes the following recommendations:
   (a) CLR styles with ratings above 100 volts are not recommended for Grade 1 applications.
   (b) CKR style sizes recommended by GSFC are limited to maximum capacitance values as follows:
   CKR05—33,000 pf CKR11—4,700 pf CKR14—47,000 pf
   CKR06—330,000 pf CKR12—10,000 pf CKR15—180,000 pf
   (c) CKR styles for use in Grade 1 applications shall be purchased to revision C of MIL-C-39014.
   (d) CSR13 styles rated for 100 volts rather than 75 volts should be used where identical capacitance values are available at both voltages.
   (e) CSR33 styles are not recommended for power line application where parts see power cycling or current surge conditions, CLR79 styles are preferred for such applications.

# MIL-C-55681, CAPACITORS

## Fixed, Chip, Multiple Layer, Unencapsulated, Ceramic Dielectric, Established Reliability[1]

Part Number example: **CDRXX** **BV*** **XXX** **W*** **T*** **S** **Z***

**STYLE** – "CDR" Multiple layers, fixed, ceramic dielectric, encapsulated, established reliability. XX = size code (see dimensions)

**RATED TEMPERATURE AND VOLTAGE – TEMPERATURE LIMITS** – "B" indicates the rated temperature range of 218K to 398K; "V"" the voltage - temperature limits in accordance with the following table:

| V | Capacitance Change referenced to 298K | |
|---|---|---|
| | 0 Volts Applied | Rated Volts Applied |
| P | 0 ± 30 ppm/k ±15% | 0 ± 30 ppm/k +15% –25% |
| X | | |

**CAPACITANCE** – The nominal value, expressed in picofarads; the first two digits represent significant figures and the last digit specifies the number of zeros to follow.

**RATED VOLTAGE** – for continuous operation at 398K, is specified in accordance with the following table:

| W | Volts, DC |
|---|---|
| A | 50 |
| B | 100 |

**CAPACITANCE TOLERANCE** – is specified in accordance with the following table:

| T | (± %) |
|---|---|
| J | 5 |
| K | 10 |
| M | 20 |

**TERMINATION FINISH** – "S"[2]

| S | Finish |
|---|---|
| S | Solder |
| N | Gold |

**FAILURE RATE LEVEL (FRL)** – is specified in accordance with the following table:

| Z | (%/1000 hrs.) |
|---|---|
| P | 0.1 |
| R | 0.01 |

| Military Style | See Page 01– | Capacitance Range (pF) | Capacitance Tolerances T | DC Voltage Ratings W | Characteristics BV | Maximum D.F. (%) for BP | Maximum D.F. (%) for BX | Insulation Resistance | Dimensions (Millimeters, Max.) L | Dimensions (Millimeters, Max.) W | Dimensions (Millimeters, Max.) T | Grade 1 FRL | Grade 2 FRL | Manufacturer |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CDR01<br>CDR02<br>CDR03 | 3 | 10–4700<br>220–22000<br>330–68000 | J,K,M | A,B | BP,BX | 0.15 | 2.5 | 100K megohm for C<10nF<br>1K megohm-uF for C≥10nF[3] | 2.41<br>4.95<br>4.95 | 1.65<br>1.65<br>2.41 | 1.40<br>1.40<br>2.03 | R | P | QPL-55681 |

NOTES:

1. For helpful information dealing with the handling, use, and protection of these chips, refer to AID No. 01-01 available from Parts Branch Library (301) 344-7240.
2. MIL-C-55681 specifies additional codes and finishes for these devices for soldering or thermocompression bonding. These parts are not intended for welding.
3. Insulation resistance = X/C, where X = 1000 megohm-microfarads and C is in microfarads.

## MIL-C-55681, STYLE CDR01
## Fixed, Chip, Ceramic Dielectric, Established Reliability

| Part Number[1,2] | Capacitance | | Characteristic BV* | Rated Voltage (volts, dc) |
|---|---|---|---|---|
| | Nominal Value (pF) | Tolerance T* | | |
| CDR01BP100BT*SZ* | 10 | J,K | BP | 100 |
| 120BT*SZ* | 12 | J | | |
| 150BT*SZ* | 15 | J,K | | |
| 180BT*SZ* | 18 | J | | |
| 220BT*SZ* | 22 | J,K | | |
| CDR01BP270BT*SZ* | 27 | J | | |
| 330BT*SZ* | 33 | J,K | | |
| 390BT*SZ* | 39 | J | | |
| 470BT*SZ* | 47 | J,K | | |
| 560BT*SZ* | 56 | J | | |
| CDR01BP680BT*SZ* | 68 | J,K | | |
| 820BT*SZ* | 82 | J | | |
| 101BT*SZ* | 100 | J,K | | |
| 121BT*SZ* | 120 | J,K | | |
| 151BT*SZ* | 150 | J,K | | |
| 181BT*SZ* | 180 | J,K | | |
| CDR01BX221BT*SZ* | 220 | K,M | BX | |
| 271BT*SZ* | 270 | K | | |
| 331BT*SZ* | 330 | K,M | | |
| 391BT*SZ* | 390 | K | | |
| 471BT*SZ* | 470 | K,M | | |
| CDR01BX561BT*SZ* | 560 | K | | |
| 681BT*SZ* | 680 | K,M | | |
| 821BT*SZ* | 820 | K | | |
| 102BT*SZ* | 1,000 | K,M | | |
| 122BT*SZ* | 1,200 | K | | |
| CDR01BX152BT*SZ* | 1,500 | K,M | | |
| 182BT*SZ* | 1,800 | K | | |
| 222BT*SZ* | 2,200 | K,M | | |
| 272BT*SZ* | 2,700 | K | | |
| 332BT*SZ* | 3,300 | K,M | | |
| CDR01BX392AT*SZ* | 3,900 | K | | 50 |
| CDR01BX472AT*SZ* | 4,700 | K,M | | |

NOTES:
1. Refer to Page 01-2; Complete part number must include the following: S – Termination finish symbol; T*– Capacitance tolerance symbol; Z*– Failure rate level symbol
2. For helpful information dealing with the handling, use, and protection of these chips, refer to AID No. 01-01, available from the Parts Branch Library.

## MIL-C-55681, STYLE CDR02
## Fixed, Chip, Ceramic Dielectric, Established Reliability

| Part Number[1,2] | Capacitance | | Characteristic BV* | Rated Voltage (volts, dc) |
|---|---|---|---|---|
| | Nominal Value (pF) | Tolerance K* | | |
| CDR02BP221BT*SZ* | 220 | J,K | BP | 100 |
| CDR02BP271BT*SZ* | 270 | J | | |
| CDR02BX392BT*SZ* | 3,900 | K | BX | |
| 472BT*SZ* | 4,700 | K,M | | |
| 562BT*SZ* | 5,600 | K | | |
| 682BT*SZ* | 6,800 | K,M | | |
| 822BT*SZ* | 8,200 | K | | |
| 103BT*SZ* | 10,000 | K,M | | |
| CDR02BX123AT*SZ* | 12,000 | K | | 50 |
| 153AT*SZ* | 15,000 | K,M | | |
| 183AT*SZ* | 18,000 | K | | |
| 223AT*SZ* | 22,000 | K,M | | |

## MIL-C-55681, STYLE CDR03
## Fixed, Chip, Ceramic Dielectric, Established Reliability

| Part Number[1,2] | Capacitance | | Characteristic BV* | Rated Voltage (volts, dc) |
|---|---|---|---|---|
| | Nominal Value (pF) | Tolerance T* | | |
| CDR03BP331BT*SZ* | 330 | J,K | BP | 100 |
| 391BT*SZ* | 390 | J | | |
| 471BT*SZ* | 470 | J,K | | |
| 561BT*SZ* | 560 | J | | |
| 681BT*SZ* | 680 | J,K | | |
| 821BT*SZ* | 820 | J | | |
| 102BT*SZ* | 1,000 | J,K | | |
| CDR03BX123BT*SZ* | 12,000 | K | BX | |
| 153BT*SZ* | 15,000 | K,M | | |
| 183BT*SZ* | 18,000 | K | | |
| 223BT*SZ* | 22,000 | K,M | | |
| 273BT*SZ* | 27,000 | K | | |
| 333BT*SZ* | 33,000 | K,M | | |
| CDR03BX393AT*SZ* | 39,000 | K | | 50 |
| 473AT*SZ* | 47,000 | K,M | | |
| 563AT*SZ* | 56,000 | K | | |
| 683AT*SZ* | 68,000 | K,M | | |

# MIL-C-23269, CAPACITORS
## Fixed, Glass Dielectric, Established Reliability

Part Number example: **M23269** **/XX** **XXXX**

M-Number – identifies "CYR" fixed, glass dielectric, established reliability capacitors conforming to MIL-C-23269.

/XX – identifies the appropriate military specification sheet that uniquely specifies the capacitor family.

XXXX – uniquely specifies the nominal capacitance value, capacitance tolerance, rated dc voltage, and failure rate level (%/1000 hours).

| Part Number | Military Style | See Page 01– | Capacitance Range (pF) | Dissipation Factor (%) | Rated Voltage (volts, dc) | Temperature | | Insulation Resistance (megohms) | Configuration | | Grade 1 FRL | Grade 2 FRL | Manufacturer |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Range °C | Coefficient (ppm/°C) | | Case Type | Lead Type | | | |
| **M23269/05** | CYR13 | 5, 6 | 0.5–300 | 0.7, 0.3, 0.1 | 300, 500 | −55°C to +125°C | 105±25 | 500K | Rectangular glass, hermetic | Axial or Radial | R | P | QPL-23269 |
| **M23269/09** | CYR41 | 7 | 0.5–1000 | | 100 | | 0±25 | | | Radial | R[1] | P | |
| | CYR42 | 8 | 0.5–300 | | 50–500 | | | | | Axial | | | |
| | CYR43 | 9 | 330–1200 | 0.1 | 50–300 | | | | | Axial | | | |
| **M23269/10** | CYR51 | 10, 11 | 1–560 | 0.2, 0.1 | 300 | | 140±25 | 100K | Rectangular –epoxy | Radial | R[1] | M | |
| | CYR52 | 12 | 620–1000 | 0.1 | | | | | | | | | |
| | CYR53 | 12 | 1100–2400 | 0.1 | | | | | | | | | |

NOTES:

1. These parts are not available at FRL "R" at this time. If these parts must be used, use Grade 2 parts and consult parts engineering for further reliability information on these parts.

# M23269/05, STYLE CYR13
## Fixed, Glass Dielectric, Established Reliability

| Capacitance | | Dissipation Factor (%) | Rated Voltage (volts, dc) | Part Number M23269/05- | |
|---|---|---|---|---|---|
| Value (pF) | Tolerance (±) | | | Grade 1 FRL = R(0.01) | Grade 2 FRL = P(0.1) |
| 0.5 | 0.25pF | 0.7 | 500 | 5001 | 4001 |
| 1.0 | 0.25pF | | | 5002 | 4002 |
| 1.5 | 0.25pF | | | 5003 | 4003 |
| 2.2 | 0.25pF | | | 5004 | 4004 |
| | 0.50pF | | | 5005 | 4005 |
| 2.7 | 0.25pF | | | 5006 | 4006 |
| 3.0 | 0.25pF | | | 5007 | 4007 |
| | 0.50pF | | | 5008 | 4008 |
| 3.3 | 0.25pF | | | 5009 | 4009 |
| 3.6 | 0.25pF | | | 5010 | 4010 |
| | 0.50pF | | | 5011 | 4011 |
| 3.9 | 0.25pF | | | 5012 | 4012 |
| 4.3 | 0.25pF | | | 5013 | 4013 |
| | 0.50pF | | | 5014 | 4014 |
| 4.7 | 0.25pF | | | 5015 | 4015 |
| 5.1 | 0.25pF | 0.3 | | 5016 | 4016 |
| 5.6 | 0.25pF | | | 5017 | 4017 |
| | 5% | | | 5018 | 4018 |
| 6.2 | 0.25pF | | | 5019 | 4019 |
| | 5% | | | 5020 | 4020 |
| 6.8 | 0.25pF | | | 5021 | 4021 |
| | 5% | | | 5022 | 4022 |
| 7.5 | 0.25pF | | | 5023 | 4023 |
| | 5% | | | 5024 | 4024 |
| 8.2 | 0.25pF | | | 5025 | 4025 |
| | 5% | | | 5026 | 4026 |
| 9.1 | 0.25pF | | | 5027 | 4027 |
| | 5% | | | 5028 | 4028 |
| 10 | 0.25pF | | | 5029 | 4029 |
| | 5% | | | 5030 | 4030 |
| 11 | 0.25pF | | | 5031 | 4031 |
| | 5% | | | 5032 | 4032 |

| Capacitance | | Dissipation Factor (%) | Rated Voltage (volts, dc) | Part Number M23269/05- | |
|---|---|---|---|---|---|
| Value (pF) | Tolerance (±) | | | Grade 1 FRL = R(0.01) | Grade 2 FRL = P(0.1) |
| 12 | 0.25pF | 0.3 | 500 | 5033 | 4033 |
| | 5% | | | 5034 | 4034 |
| 13 | 2% | | | 5035 | 4035 |
| | 5% | | | 5036 | 4036 |
| 15 | 2% | | | 5037 | 4037 |
| | 5% | | | 5038 | 4038 |
| 16 | 2% | | | 5039 | 4039 |
| | 5% | | | 5040 | 4040 |
| 18 | 2% | | | 5041 | 4041 |
| | 5% | | | 5042 | 4042 |
| 20 | 2% | | | 5043 | 4043 |
| | 5% | | | 5044 | 4044 |
| 22 | 2% | | | 5045 | 4045 |
| | 5% | | | 5046 | 4046 |
| 24 | 2% | | | 5047 | 4047 |
| | 5% | | | 5048 | 4048 |
| 27 | 1% | | | 5049 | 4049 |
| | 2% | | | 5050 | 4050 |
| | 5% | | | 5051 | 4051 |
| 30 | 1% | 0.1 | | 5052 | 4052 |
| | 2% | | | 5053 | 4053 |
| | 5% | | | 5054 | 4054 |
| 33 | 1% | | | 5055 | 4055 |
| | 2% | | | 5056 | 4056 |
| | 5% | | | 5057 | 4057 |
| 36 | 1% | | | 5058 | 4058 |
| | 2% | | | 5059 | 4059 |
| | 5% | | | 5060 | 4060 |
| 39 | 1% | | | 5061 | 4061 |
| | 2% | | | 5062 | 4062 |
| | 5% | | | 5063 | 4063 |
| 43 | 1% | | | 5064 | 4064 |

## M23269/05, STYLE CYR13 (continued)
## Fixed, Glass Dielectric, Established Reliability

| Capacitance | | Dissipation Factor (%) | Rated Voltage (volts, dc) | Part Number M23269/05- | |
|---|---|---|---|---|---|
| Value (pF) | Tolerance (± %) | | | Grade 1 FRL = R(0.01) | Grade 2 FRL = P(0.1) |
| 43 | 2 | 0.1 | 500 | 5065 | 4065 |
| | 5 | | | 5066 | 4066 |
| 47 | 1 | | | 5067 | 4067 |
| | 2 | | | 5068 | 4068 |
| | 5 | | | 5069 | 4069 |
| 51 | 1 | | | 5070 | 4070 |
| | 2 | | | 5071 | 4071 |
| | 5 | | | 5072 | 4072 |
| 56 | 1 | | | 5073 | 4073 |
| | 2 | | | 5074 | 4074 |
| | 5 | | | 5075 | 4075 |
| 62 | 1 | | | 5076 | 4076 |
| | 2 | | | 5077 | 4077 |
| | 5 | | | 5078 | 4078 |
| 68 | 1 | | | 5079 | 4079 |
| | 2 | | | 5080 | 4080 |
| | 5 | | | 5081 | 4081 |
| 75 | 1 | | | 5082 | 4082 |
| | 2 | | | 5083 | 4083 |
| | 5 | | | 5084 | 4084 |
| 82 | 1 | | | 5085 | 4085 |
| | 2 | | | 5086 | 4086 |
| | 5 | | | 5087 | 4087 |
| 91 | 1 | | | 5088 | 4088 |
| | 2 | | | 5089 | 4089 |
| | 5 | | | 5090 | 4090 |
| 100 | 1 | | | 5091 | 4091 |
| | 2 | | | 5092 | 4092 |
| | 5 | | | 5093 | 4093 |
| 110 | 1 | | | 5094 | 4094 |
| | 2 | | | 5095 | 4095 |

| Capacitance | | Dissipation Factor (%) | Rated Voltage (volts, dc) | Part Number M23269/05- | |
|---|---|---|---|---|---|
| Value (pF) | Tolerance (± %) | | | Grade 1 FRL = R(0.01) | Grade 2 FRL = P(0.1) |
| 110 | 5 | 0.1 | 500 | 5096 | 4096 |
| 120 | 1 | | | 5097 | 4097 |
| | 2 | | | 5098 | 4098 |
| | 5 | | | 5099 | 4099 |
| 130 | 1 | | | 5100 | 4100 |
| | 2 | | | 5101 | 4101 |
| | 5 | | | 5102 | 4102 |
| 150 | 1 | | | 5103 | 4103 |
| | 2 | | | 5104 | 4104 |
| | 5 | | | 5105 | 4105 |
| 160 | 1 | | | 5106 | 4106 |
| | 2 | | | 5107 | 4107 |
| | 5 | | | 5108 | 4108 |
| 180 | 1 | | | 5109 | 4109 |
| | 2 | | | 5110 | 4110 |
| | 5 | | | 5111 | 4111 |
| 200 | 1 | | | 5112 | 4112 |
| | 2 | | | 5113 | 4113 |
| | 5 | | | 5114 | 4114 |
| 220 | 1 | | 300 | 5115 | 4115 |
| | 2 | | | 5116 | 4116 |
| | 5 | | | 5117 | 4117 |
| 240 | 1 | | | 5118 | 4118 |
| | 2 | | | 5119 | 4119 |
| | 5 | | | 5120 | 4120 |
| 270 | 1 | | | 5121 | 4121 |
| | 2 | | | 5122 | 4122 |
| | 5 | | | 5123 | 4123 |
| 300 | 1 | | | 5124 | 4124 |
| | 2 | | | 5125 | 4125 |
| | 5 | | | 5126 | 4126 |

## M23269/09, STYLE CYR41
## Fixed, Glass Dielectric, Established Reliability

| Capacitance | | Dissipation Factor (%) | Rated Voltage (volts, dc) | Part Number M23269/09- |
|---|---|---|---|---|
| Value (pF) | Tolerance (±) | | | Grade 1 & Grade 2 FRL = P(0.1) |
| 0.5 | 0.25pF | 0.5 | 100 | 4001 |
| 1.5 | 0.25pF | | | 4002 |
| 2.7 | 0.25pF | | | 4003 |
| 3.3 | 0.25pF | | | 4004 |
| 3.9 | 0.25pF | | | 4005 |
| 4.7 | 0.25pF | | | 4006 |
| 5.6 | 0.25pF | 0.3 | | 4007 |
| 6.8 | 0.25pF | | | 4008 |
| | 5% | | | 4009 |
| 8.2 | 0.25pF | | | 4010 |
| | 5% | | | 4011 |
| 10 | 0.25pF | | | 4012 |
| | 5% | | | 4013 |
| 12 | 0.25pF | | | 4014 |
| | 5% | | | 4015 |
| 15 | 0.25pF | | | 4016 |
| | 2% | | | 4017 |
| | 5% | | | 4018 |
| 18 | 0.25pF | | | 4019 |
| | 2% | | | 4020 |
| | 5% | | | 4021 |
| 22 | 0.25pF | | | 4022 |
| | 2% | | | 4023 |
| | 5% | | | 4024 |
| 27 | 1% | | | 4025 |
| | 2% | | | 4026 |
| | 5% | | | 4027 |
| 33 | 1% | 0.1 | | 4028 |
| | 2% | | | 4029 |
| | 5% | | | 4030 |
| 39 | 1% | | | 4031 |
| | 2% | | | 4032 |
| | 5% | | | 4033 |
| 47 | 1% | | | 4034 |
| | 2% | | | 4035 |
| | 5% | | | 4036 |
| 56 | 1% | | | 4037 |
| | 2% | | | 4038 |
| | 5% | | | 4039 |
| 68 | 1% | | | 4040 |
| | 2% | | | 4041 |
| | 5% | | | 4042 |

| Capacitance | | Dissipation Factor (%) | Rated Voltage (volts, dc) | Part Number M23269/09- |
|---|---|---|---|---|
| Value (pF) | Tolerance (± %) | | | Grade 1 & Grade 2 FRL = P(0.1) |
| 82 | 1 | 0.1 | 100 | 4043 |
| | 2 | | | 4044 |
| | 5 | | | 4045 |
| 100 | 1 | | | 4046 |
| | 2 | | | 4047 |
| | 5 | | | 4048 |
| 120 | 1 | | | 4049 |
| | 2 | | | 4050 |
| | 5 | | | 4051 |
| 150 | 1 | | | 4052 |
| | 2 | | | 4053 |
| | 5 | | | 4054 |
| 180 | 1 | | | 4055 |
| | 2 | | | 4056 |
| | 5 | | | 4057 |
| 220 | 1 | | | 4058 |
| | 2 | | | 4059 |
| | 5 | | | 4060 |
| 270 | 1 | | | 4061 |
| | 2 | | | 4062 |
| | 5 | | | 4063 |
| 330 | 1 | | | 4064 |
| | 2 | | | 4065 |
| | 5 | | | 4066 |
| 390 | 1 | | | 4067 |
| | 2 | | | 4068 |
| | 5 | | | 4069 |
| 470 | 1 | | | 4070 |
| | 2 | | | 4071 |
| | 5 | | | 4072 |
| 560 | 1 | | | 4073 |
| | 2 | | | 4074 |
| | 5 | | | 4075 |
| 680 | 1 | | | 4076 |
| | 2 | | | 4077 |
| | 5 | | | 4078 |
| 820 | 1 | | | 4079 |
| | 2 | | | 4080 |
| | 5 | | | 4081 |
| 1000 | 1 | | | 4082 |
| | 2 | | | 4083 |
| | 5 | | | 4084 |

# M23269/09, STYLE CYR42
## Fixed, Glass Dielectric, Established Reliability

| Capacitance | | Dissipation Factor (%) | Rated Voltage (volts, dc) | Part Number M23269/09- |
|---|---|---|---|---|
| Value (pF) | Tolerance (±) | | | Grade 1 & Grade 2 FRL = P(0.1) |
| 0.5 | 0.25pF | 0.7 | 500 | 4101 |
| 1.5 | 0.25pF | | | 4102 |
| 2.7 | 0.25pF | | | 4103 |
| 3.3 | 0.25pF | | | 4104 |
| 3.9 | 0.25pF | | | 4105 |
| 4.7 | 0.25pF | | | 4106 |
| 5.6 | 0.25pF | 0.3 | | 4107 |
| 6.8 | 0.25pF | | | 4108 |
| | 5% | | | 4109 |
| 8.2 | 0.25pF | | | 4110 |
| | 5% | | | 4111 |
| 10 | 0.25pF | | | 4112 |
| | 5% | | | 4113 |
| 12 | 0.25pF | | | 4114 |
| | 5% | | | 4115 |
| 15 | 0.25pF | | | 4116 |
| | 2% | | | 4117 |
| | 5% | | | 4118 |
| 18 | 0.25pF | | | 4119 |
| | 2% | | | 4120 |
| | 5% | | | 4121 |
| 22 | 0.25pF | | | 4122 |
| | 2% | | | 4123 |
| | 5% | | | 4124 |
| 27 | 1% | | | 4125 |
| | 2% | | | 4126 |
| | 5% | | | 4127 |
| 33 | 1% | 0.1 | | 4128 |
| | 2% | | | 4129 |
| | 5% | | | 4130 |
| 39 | 1% | | | 4131 |
| | 2% | | | 4132 |
| | 5% | | | 4133 |

| Capacitance | | Dissipation Factor (%) | Rated Voltage (volts, dc) | Part Number M23269/09- |
|---|---|---|---|---|
| Value (pF) | Tolerance (± %) | | | Grade 1 & Grade 2 FRL = P(0.1) |
| 47 | 1 | 0.1 | 500 | 4134 |
| | 2 | | | 4135 |
| | 5 | | | 4136 |
| 56 | 1 | | | 4137 |
| | 2 | | | 4138 |
| | 5 | | | 4139 |
| 68 | 1 | | 300 | 4140 |
| | 2 | | | 4141 |
| | 5 | | | 4142 |
| 82 | 1 | | | 4143 |
| | 2 | | | 4144 |
| | 5 | | | 4145 |
| 100 | 1 | | 100 | 4146 |
| | 2 | | | 4147 |
| | 5 | | | 4148 |
| 120 | 1 | | | 4149 |
| | 2 | | | 4150 |
| | 5 | | | 4151 |
| 150 | 1 | | | 4152 |
| | 2 | | | 4153 |
| | 5 | | | 4154 |
| 180 | 1 | | | 4155 |
| | 2 | | | 4156 |
| | 5 | | | 4157 |
| 220 | 1 | | | 4158 |
| | 2 | | | 4159 |
| | 5 | | | 4160 |
| 270 | 1 | | 50 | 4161 |
| | 2 | | | 4162 |
| | 5 | | | 4163 |
| 300 | 1 | | | 4164 |
| | 2 | | | 4165 |
| | 5 | | | 4166 |

## M23269/09, STYLE CYR43
## Fixed, Glass Dielectric, Established Reliability

| Capacitance | | Rated Voltage (volts, dc) | Part Number M23269/09- |
|---|---|---|---|
| Value (pF) | Tolerance (± %) | | Grade 1 & Grade 2 FRL = P(0.1) |
| 330 | 1 | 300 | 4301 |
| | 2 | | 4302 |
| | 5 | | 4303 |
| 390 | 1 | | 4304 |
| | 2 | | 4305 |
| | 5 | | 4306 |
| 470 | 1 | 100 | 4307 |
| | 2 | | 4308 |
| | 5 | | 4309 |
| 560 | 1 | | 4310 |
| | 2 | | 4311 |
| | 5 | | 4312 |
| 680 | 1 | | 4313 |
| | 2 | | 4314 |
| | 5 | | 4315 |

| Capacitance | | Rated Voltage (volts, dc) | Part Number M23269/09- |
|---|---|---|---|
| Value (pF) | Tolerance (± %) | | Grade 1 & Grade 2 FRL = P(0.1) |
| 820 | 1 | 50 | 4316 |
| | 2 | | 4317 |
| | 5 | | 4318 |
| 1000 | 1 | | 4319 |
| | 2 | | 4320 |
| | 5 | | 4321 |
| 1200 | 1 | | 4322 |
| | 2 | | 4323 |
| | 5 | | 4324 |

# M23269/10, STYLE CYR51
## Fixed, Glass Dielectric, Established Reliability

| Capacitance | | Dissipation Factor (%) | Rated Voltage (volts, dc) | Part Number M23269/10- |
|---|---|---|---|---|
| Value (pF) | Tolerance (±) | | | Grade 1 & Grade 2 FRL = M(1.0) |
| 1 | 0.25pF | 0.2 | 300 | 3001 |
| 1.5 | 0.25pF | | | 3002 |
| 2.2 | 0.25pF | | | 3003 |
| 2.7 | 0.25pF | | | 3004 |
| 3.0 | 0.25pF | | | 3005 |
| 3.3 | 0.25pF | | | 3006 |
| 3.6 | 0.25pF | | | 3007 |
| 3.9 | 0.25pF | | | 3008 |
| 4.3 | 0.25pF | | | 3009 |
| 4.7 | 0.25pF | | | 3010 |
| 5.1 | 0.25pF | | | 3011 |
| | 5% | | | 3012 |
| 5.6 | 0.25pF | | | 3013 |
| | 5% | | | 3014 |
| 6.2 | 0.25pF | | | 3015 |
| | 5% | | | 3016 |
| 6.8 | 0.25pF | | | 3017 |
| | 5% | | | 3018 |
| 7.5 | 0.25pF | | | 3019 |
| | 5% | | | 3020 |
| 8.2 | 0.25pF | | | 3021 |
| | 5% | | | 3022 |
| 9.1 | 0.25pF | | | 3023 |
| | 5% | | | 3024 |
| 10 | 0.25pF | | | 3025 |
| | 5% | | | 3026 |
| 11 | 0.25pF | | | 3027 |
| | 5% | | | 3028 |
| 12 | 0.25pF | | | 3029 |
| | 5% | | | 3030 |
| 13 | 0.25pF | | | 3031 |
| | 2% | | | 3032 |
| | 5% | | | 3033 |
| 15 | 0.25pF | | | 3034 |
| | 2% | | | 3035 |
| | 5% | | | 3036 |
| 16 | 0.25pF | | | 3037 |
| | 2% | | | 3038 |
| 16 | 5% | 0.2 | 300 | 3039 |
| 18 | 0.25pF | | | 3040 |
| | 2% | | | 3041 |
| | 5% | | | 3042 |
| 20 | 0.25pF | | | 3043 |
| | 2% | | | 3044 |
| | 5% | | | 3045 |
| 22 | 0.25pF | | | 3046 |
| | 2% | | | 3047 |
| | 5% | | | 3048 |
| 24 | 0.25pF | | | 3049 |
| | 2% | | | 3050 |
| | 5% | | | 3051 |
| 27 | 1% | | | 3052 |
| | 2% | | | 3053 |
| | 5% | | | 3054 |
| 30 | 1% | | | 3055 |
| | 2% | | | 3056 |
| | 5% | | | 3057 |
| 33 | 1% | | | 3058 |
| | 2% | | | 3059 |
| | 5% | | | 3060 |
| 36 | 1% | | | 3061 |
| | 2% | | | 3062 |
| | 5% | | | 3063 |
| 39 | 1% | | | 3064 |
| | 2% | | | 3065 |
| | 5% | | | 3066 |
| 43 | 1% | | | 3067 |
| | 2% | | | 3068 |
| | 5% | | | 3069 |
| 47 | 1% | | | 3070 |
| | 2% | | | 3071 |
| | 5% | | | 3072 |
| 51 | 1% | | | 3073 |
| | 2% | | | 3074 |
| | 5% | | | 3075 |
| 56 | 1% | | | 3076 |

## M23269/10, STYLE CYR51 (continued)
## Fixed, Glass Dielectric, Established Reliability

| Capacitance | | Dissipation Factor (%) | Rated Voltage (volts, dc) | Part Number M23269/10- |
|---|---|---|---|---|
| Value (pF) | Tolerance (± %) | | | Grade 1 & Grade 2 FRL = M(1.0) |
| 56 | 2 | 0.2 | 300 | 3077 |
| | 5 | | | 3078 |
| 62 | 1 | | | 3079 |
| | 2 | | | 3080 |
| | 5 | | | 3081 |
| 68 | 1 | | | 3082 |
| | 2 | | | 3083 |
| | 5 | | | 3084 |
| 75 | 1 | | | 3085 |
| | 2 | | | 3086 |
| | 5 | | | 3087 |
| 82 | 1 | | | 3088 |
| | 2 | | | 3089 |
| | 5 | | | 3090 |
| 91 | 1 | | | 3091 |
| | 2 | | | 3092 |
| | 5 | | | 3093 |
| 100 | 1 | | | 3094 |
| | 2 | | | 3095 |
| | 5 | | | 3096 |
| 110 | 1 | 0.1 | | 3097 |
| | 2 | | | 3098 |
| | 5 | | | 3099 |
| 120 | 1 | | | 3100 |
| | 2 | | | 3101 |
| | 5 | | | 3102 |
| 130 | 1 | | | 3103 |
| | 2 | | | 3104 |
| | 5 | | | 3105 |
| 150 | 1 | | | 3106 |
| | 2 | | | 3107 |
| | 5 | | | 3108 |
| 160 | 1 | | | 3109 |
| | 2 | | | 3110 |
| | 5 | | | 3111 |
| 180 | 1 | | | 3112 |
| | 2 | | | 3113 |

| Capacitance | | Dissipation Factor (%) | Rated Voltage (volts, dc) | Part Number M23269/10- |
|---|---|---|---|---|
| Value (pF) | Tolerance (± %) | | | Grade 1 & Grade 2 FRL = M(1.0) |
| 180 | 5 | 0.1 | 300 | 3114 |
| 200 | 1 | | | 3115 |
| | 2 | | | 3116 |
| | 5 | | | 3117 |
| 220 | 1 | | | 3118 |
| | 2 | | | 3119 |
| | 5 | | | 3120 |
| 240 | 1 | | | 3121 |
| | 2 | | | 3122 |
| | 5 | | | 3123 |
| 270 | 1 | | | 3124 |
| | 2 | | | 3125 |
| | 5 | | | 3126 |
| 300 | 1 | | | 3127 |
| | 2 | | | 3128 |
| | 5 | | | 3129 |
| 330 | 1 | | | 3130 |
| | 2 | | | 3131 |
| | 5 | | | 3132 |
| 360 | 1 | | | 3133 |
| | 2 | | | 3134 |
| | 5 | | | 3135 |
| 390 | 1 | | | 3136 |
| | 2 | | | 3137 |
| | 5 | | | 3138 |
| 430 | 1 | | | 3139 |
| | 2 | | | 3140 |
| | 5 | | | 3141 |
| 470 | 1 | | | 3142 |
| | 2 | | | 3143 |
| | 5 | | | 3144 |
| 510 | 1 | | | 3145 |
| | 2 | | | 3146 |
| | 5 | | | 3147 |
| 560 | 1 | | | 3148 |
| | 2 | | | 3149 |
| | 5 | | | 3150 |

## M23269/10, STYLE CYR52
### Fixed, Glass Dielectric, Established Reliability

| Capacitance | | Rated Voltage (volts, dc) | Part Number M23269/10- |
|---|---|---|---|
| Value (pF) | Tolerance (± %) | | Grade 1 & Grade 2 FRL = M(1.0) |
| 620 | 1 | 300 | 3201 |
| | 2 | | 3202 |
| | 5 | | 3203 |
| 680 | 1 | | 3204 |
| | 2 | | 3205 |
| | 5 | | 3206 |
| 750 | 1 | | 3207 |
| | 2 | | 3208 |
| | 5 | | 3209 |
| 820 | 1 | | 3210 |
| | 2 | | 3211 |
| | 5 | | 3212 |
| 910 | 1 | | 3213 |
| | 2 | | 3214 |
| | 5 | | 3215 |
| 1000 | 1 | | 3216 |
| | 2 | | 3217 |
| | 5 | | 3218 |

## M23269/10, STYLE CYR53
### Fixed, Glass Dielectric, Established Reliability

| Capacitance | | Rated Voltage (volts, dc) | Part Number M23269/10- |
|---|---|---|---|
| Value (pF) | Tolerance (± %) | | Grade 1 & Grade 2 FRL = M(1.0) |
| 1100 | 1 | 300 | 3301 |
| | 2 | | 3302 |
| | 5 | | 3303 |
| 1200 | 1 | | 3304 |
| | 2 | | 3305 |
| | 5 | | 3306 |
| 1300 | 1 | | 3307 |
| | 2 | | 3308 |
| | 5 | | 3309 |
| 1500 | 1 | | 3310 |
| | 2 | | 3311 |
| | 5 | | 3312 |
| 1600 | 1 | | 3313 |
| | 2 | | 3314 |
| | 5 | | 3315 |
| 1800 | 1 | | 3316 |
| | 2 | | 3317 |
| | 5 | | 3318 |
| 2000 | 1 | | 3319 |
| | 2 | | 3320 |
| | 5 | | 3321 |
| 2200 | 1 | | 3322 |
| | 2 | | 3323 |
| | 5 | | 3324 |
| 2400 | 1 | | 3325 |
| | 2 | | 3326 |
| | 5 | | 3327 |

## Index of Preferred Connectors

| Style | Description | Specification | Refer To |
|---|---|---|---|
| G311P10 | Power Connectors, Solder Contacts (sub-miniature) | GSFC S-311-P-10 | Page 02-2 |
| 311P409 and 311P405 | Power Connectors, Removable Contacts (sub-miniature) | GSFC S-311-P-4/9 and 4/5 | Page 02-3 |
| 311P407 | Power connectors, Crimp Removable Contacts (sub-miniature High Density) | GSFC S311P-4/7 | Page 02-4 |
| 40M38277 | High Density, Miniature | MSFC | MIL-STD-975 |
| 40M39569 | Miniature (200°C) | MSFC | MIL-STD-975 |
| MS3450 | Threaded coupling, AN Type | MIL-C-5015 | MIL-STD-975 |
| M24308 | Rectangular, Miniature, Solder Contact | MIL-C-24308 | MIL-STD-975 |
| M24308 | Rectangular, Miniature, Crimp Removable contacts, and High Density Miniature | MIL-C-24308 | MIL-STD-975 |
| MS3470 | Circular, Miniature, Quick Disconnect | MIL-C-26482 | MIL-STD-975 |
| MS27466 | Miniature, High Density, Quick Disconnect | MIL-C-38999 | MIL-STD-975 |
| MS27472 | Miniature, High Density, Quick Disconnect | MIL-C-38999 | MIL-STD-975 |
| M39012 | Coaxial, Radio Frequency | MIL-C-39012 | MIL-STD-975 |
| MS17343 | Circular, Heavy Duty, Quick Disconnect | MIL-C-22992 | MIL-STD-975 |

## POWER CONNECTORS
## Rack and Panel, Sub-Miniature, Solder Contacts

| Construction | Contacts | | For Use With Wire Size | Grade 1 | | | Grade 2 | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | Qty. | Type | | GSFC Type[1] | Specification GSFC | Manufacturer | MIL Part Number[2] | Specification[3] | Manufacturer | |
| Receptacle, Rectangular | 9 | Socket | AWG #20 max. | G311P10B-1S-C-15 | S-311-P-10 | ITT Cannon Electric | M24308/1-1 | MIL-C-24308 | QPL-24308 | All GSFC type connectors: "-15" in type indicates 0.154 inch (0.39mm) dia. mounting hole, 0.120 inch (0.31mm) dia. is available, indicate by "-12." |
| | 15 | Socket | | G311P10B-2S-C-15 | | | M24308/1-2 | | | |
| | 25 | Socket | | G311P10B-3S-C-15 | | | M24308/1-3 | | | |
| | 37 | Socket | | G311P10B-4S-C-15 | | | M24308/1-4 | | | |
| | 50 | Socket | | G311P10B-5S-C-15 | | | M24308/1-5 | | | |
| Plug, Rectangular | 9 | Pin | | G311P10-1P-C-15 | | TRW Cinch Connectors | M24308/3-1 | | | Military specification connectors: 0.120 inch dia. mounting hole. |
| | 15 | Pin | | G311P10-2P-C-15 | | | M24308/3-2 | | | |
| | 25 | Pin | | G311P10-3P-C-15 | | | M24308/3-3 | | | |
| | 37 | Pin | | G311P10-4P-C-15 | | | M24308/3-4 | | | Grade 1 and Grade 2 connectors of this type are similar in construction but are not interchangeable. |
| | 50 | Pin | | G311P10-5P-C-15 | | | M24308/3-5 | | | |

NOTES:

1. C = 20 gamma residual magnetism level; other levels B = 200 and D = 2 gamma are available.
2. Residual magnetism level is not specified. Not recomemnded for Space Flight use, and should be used for ground support application only. For grade 2 flight application use a grade 1 part.
3. The military specification prescribes relaxed quality assurance provisions when compared with GSFC S-311-P-10 (see Grade 1 Parts). For example, the GSFC specification requires 100% screening, whereas the military specification testing is on a sample basis only.

# POWER CONNECTORS
## Rack and Panel, Sub-Miniature, Crimp Removable Contacts

| Construction | Contacts | | For Use With Wire Size | Grade 1 | | | | | Grade 2 | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Shell | | Contact | | Manufacturer | MIL Part Number[2] M24308 | Specification[3] | Manufacturer | |
| | Qty. | Type | | GSFC Type[1] 311P409 | Specification GSFC | GSFC Type | Specification GSFC | | | | | |
| Receptacle, Rectangular | 9<br>15<br>25<br>37<br>50 | Socket | AWG # 20-22-24 | -1S-B-15<br>-2S-B-15<br>-3S-B-15<br>-4S-B-15<br>-5S-B-15 | S-311-P-4/9 | G10S1 | S-311-P-4/10 | AMP, Inc.<br>ITT Cannon Electric | /2-1<br>/2-2<br>/2-3<br>/2-4<br>/2-5 | MIL-C-24308 | QPL 24308 | All GSFC type connectors: "-15" type indicates 0.154 inch (0.39 mm) dia. mounting hole. 0.120 inch (0.31 mm) dia. is available, indicate by "-12." |
| Plug, Rectangular | 9<br>15<br>25<br>37<br>50 | Pin | | -1P-B-15<br>-2P-B-15<br>-3P-B-15<br>-4P-B-15<br>-5P-B-15 | | G10P1 | | TRW Cinch Connectors | /4-1<br>/4-2<br>/4-3<br>/4-4<br>/4-5 | | | Military specification connectors: 0.120 inch dia. mounting hole. |

NOTES:

1. B = 200 gamma residual magnetism level. Other levels are available when required by the application and may be selected as shown below.

| Residual Magnetism (gamma) | Shell | | Contacts | | |
|---|---|---|---|---|---|
| | GSFC Type | Specification GSFC | Pin | Socket | Specification GSFC |
| 20 | 311P405XX-C-XX | S-311-P-4/5 | GPP1 | GPS1 | S-311-P-4/6 |
| 2 | 311P405XX-D-XX | | | | |

2. Residual magnetism level is not specified. Not recommended for Space Flight use, and should be used for ground support application only. For grade 2 flight application use a grade 1 part.
3. The military specification prescribes relaxed quality assurance provisions when compared with GSFC S-311-P-4 (see Grade 1 Parts). For example, the GSFC specification requires 100% screening, whereas the military specification requires testing is on a sample basis only.

# POWER CONNECTORS

## Rack and Panel, Sub-Miniature, High Density, Crimp Removable Contacts

| Construction | Contacts | | For Use With Wire Size | Grade 1 | | | | | Grade 2 | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Shell | | Contact | | Manufacturer | MIL Part Number[2] M24308 | Specification[3] | Manufacturer | |
| | Qty. | Type | | GSFC Type[1] 311P407 | Specification GSFC | GSFC Type | Specification GSFC | | | | | |
| Receptacle, Rectangular | 15<br>26<br>44<br>62<br>78<br>104 | Socket | AWG # 22-24-26-28 | -1S-B-15<br>-2S-B-15<br>-3S-B-15<br>-4S-B-15<br>-5S-B-15<br>-6S-B-15 | S-311-P-4/7 | G08S1 | S-311-P-4/8 | Amp, Inc. | /2-11<br>/2-12<br>/2-13<br>/2-14<br>/2-15<br>/2-16 | MIL-C-24308 | QPL-24308 | All GSFC type connectors: "-15" type indicates 0.154 inch (0.39 mm) dia. mounting hole, 0.120 inch (0.31 mm) dia. is available, indicate by "-12." |
| Plug, Rectangular | 15<br>26<br>44<br>62<br>78<br>104 | Pin | | -1P-B-15<br>-2P-B-15<br>-3P-B-15<br>-4P-B-15<br>-5P-B-15<br>-6P-B-15 | | G08P1 | | | /4-11<br>/4-12<br>/4-13<br>/4-14<br>/4-15<br>/4-16 | | | Military specification connectors: 0.120 inch dia. mounting hole. |

NOTES:

1. B = 200 gamma residual magnetism level. No other residual magnetism levels are available for this type of connector.
2. Residual magnetism level is not specified. Not recommended for Space Flight use, and should be used for ground support application only. For grade 2 flight application use a grade 1 part.
3. The military specification prescribes relaxed quality assurance provisions when compared with GSFC S-311-P-4 (see Grade 1 Parts). For example, the GSFC specification requires 100% screening, whereas the military specification requires testing is on a sample basis only.

## Index of Preferred Filters

| Style | Description | Specification | Refer To |
|---|---|---|---|
| M18327/27-001 | Band Pass | MIL-F-18327 | MIL-STD-975 |
| M18327/46-001 | Band Pass | MIL-F-18327 | MIL-STD-975 |
| M18327/46-002 | Band Pass | MIL-F-18327 | MIL-STD-975 |
| S-311-P-5/3 | Electromagnetic Interference Suppression | S-311-P-5/3 (GSFC) | Page 03-2 |
| S-311-P-5/4 | Electromagnetic Interference Suppression | S-311-P-5/4 (GSFC) | Page 03-2 |

## FILTERS
### Electromagnetic Interference (EMI) Suppression

| Description | Voltage Rating (VDC) (@ 85°C) | Insertion Loss (25°C, No-Load) | | GSFC Specification | Grade 1 | Grade 2 | Remarks |
|---|---|---|---|---|---|---|---|
| | | Freq. Range | DB Range | | Manufacturer & Part Type[1] | | |
| L Section, Hermetically Sealed, Stud-Mounted | 35 | 10 MHz thru 1 GHz<br>150 kHz | >64 db<br>>25 db | S-311-P-5/3 | Erie S-311-P-5/3 | | Inductor at threaded end. Similar to Erie 9200-530-0025 |
| L Section, Hermetically Sealed, Stud-Mounted | 35 | 10 MHz thru 1 GHz<br>150 kHz | >64 db<br>>25 db | S-311-P-5/4 | Erie S-311-P-5/4 | | Capacitor at threaded end. Similar to Erie 9215-530-0025 |

NOTES:
1. In addition to the requirements of the specification, parts should be procured with a radiographic inspection consisting of two views perpendicular to each other and to the major axis of the device.

## FILTERS
### Band Pass

The MIL-F-18327 band pass filters listed in MIL-STD-975 are not recommended for flight or critical ground applications. They should be used only in non-critical ground applications. Consult the GSFC Parts Branch (Code 311) for assistance in the selection and testing of band pass filters.

# FUSE
## Subminiature
## (Axial Leads)

| Current Rating[3] (Amperes) | Maximum Rated Voltage (Volts) | Maximum Short Circuit Interrupt Current @ Rated VDC (Amperes) | Grade 1[1,4] | | | | | Grade 2[2] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Voltage Drop @ Rated Current (Min-Max) (Volts) | Maximum Cold Resistance (ohms) | Mil Part Number | Specification | Manufacturer | Voltage Drop @ Rated Current (Min-Max) (Volts) | Maximum Cold Resistance (ohms) | Mil Part Number | Specification | Manufacturer |
| 1/8 | 125 | 300 | .85-1.15 | 2.37 | FM08A125V 1/8A | MIL-F-23419/8 | QPL-23419 | .85-1.15 | 2.70 | FM04A125V 1/8A | MIL-F-23419/4 | QPL-23419 |
| 1/4 | | | .590-.800 | .781 | FM08A125V 1/4A | | | .544-.736 | .960 | FM04A125V 1/4A | | |
| 3/8 | | | .527-.713 | .462 | FM08A125V 3/8A | | | .527-.713 | .560 | FM04A125V 3/8A | | |
| 1/2 | | | .488-.660 | .308 | FM08A125V 1/2A | | | .510-.690 | .365 | FM04A125V 1/2A | | |
| 3/4 | | | .145-.197 | .187 | FM08A125V 3/4A | | | .134-.182 | .215 | FM04A125V 3/4A | | |
| 1 | | | .157-.213 | .138 | FM08A125V 1A | | | .157-.213 | .165 | FM04A125V 1A | | |
| 1-1/2 | | | .153-.207 | .088 | FM08A125V 1-1/2A | | | .153-.207 | .105 | FM04A125V 1-1/2A | | |
| 2 | | | .144-.196 | .0605 | FM08A125V 2A | | | .144-.196 | .072 | FM04A125V 2A | | |
| 2-1/2 | | | .125-.169 | .0462 | FM08A125V 2-1/2A | | | - | - | 5 | | |
| 3 | | | .139-.187 | .0388 | FM08A125V 3A | | | .128-.173 | .047 | FM04A125V 3A | | |
| 4 | | | .110-.150 | .0253 | FM08A125V 4A | | | .110-.150 | .029 | FM04A125V 4A | | |
| 5 | | | .087-.118 | .0154 | FM08A125V 5A | | | .087-.118 | .019 | FM04A125V 5A | | |
| 7 | | | .087-.118 | .0110 | FM08A125V 7A | | | 5 | | | | |
| 10 | | | .073-.099 | .0066 | FM08A125V 10A | | | | | | | |
| 15 | 32 | | .065-.087 | .0044 | FM08A32V 15A | | | | | | | |

NOTES:

1. GSFC recommends additional screening for Grade 1 applications per section C-4 Table 04.
2. GSFC recommends additional screening for Grade 2 applications per section C-5 Table 04.
3. Refer to Appendix B, Table 04 for Fuse Derating outline for all applications.
4. GSFC recommends the use of redundant circuits for critical flight applications.
5. No Grade 2 part exists at the present time. Use the listed Grade 1 part.

## Index of Preferred Inductors

| MIL Style | Description | Specification | Refer To |
|---|---|---|---|
| MIL-T-27/146 | Audio Frequency, High Q | MIL-T-27 | MIL-STD-975 |
| MIL-T-27/164 | Audio Frequency, High Q | MIL-T-27 | MIL-STD-975 |
| MIL-T-27/241 | Audio Frequency, High Q | MIL-T-27 | MIL-STD-975 |
| MS21367 | Coil, Fixed, Radio Frequency, Micro Miniature, Shielded, Iron Core | MIL-C-15305 | MIL-STD-975 |
| MS21368 | Coil, Fixed, Radio Frequency, Micro Miniature, Shielded, Iron Core | MIL-C-15305 | MIL-STD-975 |
| MS21369 | Coil, Fixed, Radio Frequency, Micro Miniature, Shielded, Iron Core | MIL-C-15305 | MIL-STD-975 |
| MS90538 | Coil, Fixed, Radio Frequency, Subminiature, Iron Core | MIL-C-15305 | MIL-STD-975 |
| MIL-C-39010/01 | Coil, Fixed, Radio Frequency, Micro Miniature, Shielded, Phenolic Core | MIL-C-39010 | MIL-STD-975 |
| MIL-C-39010/02 | Coil, Fixed, Radio Frequency, Micro Miniature, Shielded, Iron Core | MIL-C-39010 | MIL-STD-975 |
| MIL-C-39010/03 | Coil, Fixed, Radio Frequency, Micro Miniature, Shielded, Ferrite Core | MIL-C-39010 | MIL-STD-975 |
| MIL-C-39010/06 | Coil, Fixed, Radio Frequency, Micro Miniature, Phenolic Core | MIL-C-39010 | MIL-STD-975 |
| MIL-C-39010/07 | Coil, Fixed, Radio Frequency, Micro Miniature, Powdered Iron Core | MIL-C-39010 | MIL-STD-975 |

## Index of Preferred Relays

| Style | Description | Specification | Refer To |
|---|---|---|---|
| P2/33 | Latching | GSFC S311 P2(06)/33 | Page 06-3 |
| P2/37 | Latching | GSFC S311 P2(06)/37 | Page 06-3 |
| P2/39 | Nonlatching | GSFC S311 P2(06)/39 | Page 06-2 |
| P2/42 | Nonlatching | GSFC S311 P2(06)/42 | Page 06-2 |
| P2/47 | Nonlatching | GSFC S311 P2(06)/47 | Page 06-2 |
| P2/48 | Nonlatching | GSFC S311 P2(06)/48 | Page 06-2 |
| P2/50 | Latching | GSFC S311 P2(06)/50 | Page 06-3 |
| P2(06)/19 | Nonlatching | GSFC S311 P2(06)/19 | Page 06-2 |
| P2(06)/23 | Nonlatching | GSFC S311 P2(06)/23 | Page 06-2 |
| P2(06)/27 | Latching | GSFC S311 P2(06)/27 | Page 06-3 |
| P2(06)/35 | Latching | GSFC S311 P2(06)/35 | Page 06-3 |
| M39016/9 | Nonlatching | MIL-R-39016/9 | Page 06-2[1] |
| M39016/11 | Nonlatching | MIL-R-39016/11 | MIL-STD-975[1] |
| M39016/12 | Latching | MIL-R-39016/12 | Page 06-3[1] |
| M39016/13 | Nonlatching | MIL-R-39016/13 | Page 06-2 |
| M39016/14 | Nonlatching | MIL-R-39016/14 | Page 06-2 |
| M39016/15 | Nonlatching | MIL-R-39016/15 | Page 06-2[1] |
| M39016/20 | Nonlatching | MIL-R-39016/20 | MIL-STD-975[1] |
| M39016/29 | Latching | MIL-R-39016/29 | Page 06-3 |
| M39016/31 | Latching | MIL-R-39016/31 | Page 06-3 |
| MS27400 | Nonlatching | MIL-R-6106 | Page 06-2 |
| MS27401 | Nonlatching | MIL-R-6106 | Page 06-2 |
| MS27742 | Latching | MIL-R-6106 | Page 06-3 |

NOTE:

1. These styles are listed in MIL-STD-975. GSFC considers these parts to be suitable only for Grade 2 ground support applications.

# Relays, Nonlatching

| Electrical Data | | | | Mechanical Data | | | Grade 1[1] | | | Grade 2[2] | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Contact Rating at 28 vdc Resistive[3] (amps) | Coil Voltage | | Nominal dc Coil Resistance (ohms) | Contact Form[4] | Package Type | Terminal Type | GSFC Part Number | Specification GSFC-S-311-P-2(06) | Mfr. | MIL Part Number | Specification[5] | Mfr. | |
| | Nominal (vdc) | Pull-in (max) (vdc) | | | | | | | | | | | |
| 1.0[6] | 26.5<br>18.0<br>12.0<br>9.0<br>6.0 | 18.0<br>13.5<br>9.0<br>6.8<br>4.5 | 1560<br>880<br>390<br>220<br>98 | 2 Form C (2PDT) | TO-5 Can | Wire Leads | P2/39-01<br>P2/39-02<br>P2/39-03<br>P2/39-04<br>P2/39-05 | /39 | Teledyne | M39016/9-006P<br>M39016/9-005P<br>M39016/9-004P<br>M39016/9-003P<br>M39016/9-002P | MIL-R-39016/9 | QPL-39016 | |
| 1.0[6] | 26.5<br>18.0<br>12.0<br>9.0<br>6.0 | 18.0<br>13.5<br>9.0<br>6.8<br>4.5 | 1560<br>880<br>390<br>220<br>98 | 2 Form C (2PDT) | TO-5 Can | Wire Leads | P-2/48-01<br>P-2/48-02<br>P-2/48-03<br>P-2/48-04<br>P-2/48-05 | /48 | Teledyne | M39016/15-005P<br>M39016/15-004P<br>M39016/15-003P<br>M39016/15-002P<br>M39016/15-001P | MIL-R-39016/15 | | Coil Transient Suppression |
| 1.0[6] | 26.5<br>12.0<br>6.0 | 13.5<br>5.4<br>2.7 | 720<br>115<br>28 | 4 Form C (4PDT) | Low[7] Profile | Pins | P-2/42-03<br>P-2/42-02<br>P-2/42-01 | /42 | GE | M39016/14-002M<br>M39016/14-007M<br>M39016/14-005M | MIL-R-39016/14 | | |
| 2.0[6] | 26.5<br>12.0<br>6.0 | 13.5<br>5.4<br>2.7 | 1350<br>210<br>56 | 2 Form C (2PDT) | 1/2 Crystal Can | Solder Lugs | P-2/47-01<br>P-2/47-02<br>P-2/47-03 | /47 | GE | M39016/13-060M<br>M39016/13-065M<br>M39016/13-064M | MIL-R-39016/13 | | |
| 10.0 | 28.0 | 18.0 | 320 | 2 Form C (2PDT) | Crystal Can | Solder Lugs | P-2(06)/23-01 | /23 | QPL-6106 (MS27401) | MS27401-1 | MIL-R-6106 | QPL-6106 | |
| | | | | | | Pins | P-2(06)/23-02 | | | MS27401-2 | | | |
| 10.0 | 28.0 | 18.0 | 290 | 4 Form C (4PDT) | One Inch Cube | Solder Lugs | P-2(06)/19-01 | /19 | QPL-6106 (MS27400) | MS27400-1 | | | |
| | | | | | | Pins | P-2(06)/19-02 | | | MS27400-2 | | | |

NOTES:

1. Parts for flight use must be obtained with unpainted enclosures.
2. For ground support only. For flight applications, use Grade 1 Part.
3. For contact ratings for other types of loads (inductive, capacitive, lamp, motor), contact the Passive Devices Section.
4. Refer to MIL-R-39016 or the NARM Engineers Relay Handbook for definitions of forms (example: form C = single break, double throw, transfer, break before make).
5. These military specifications prescribe relaxed quality assurance provisions when compared with GSFC-S-311-P-2(06), (see Grade 1 parts). For example, the GSFC specifications requires 100% pre-cap visual inspection, whereas the military specifications do not.
6. Contacts also rated for low level applications.
7. 15.5 mm x 15.5 mm x 8.1 mm high (.610" x .610" x .320").

## Relays, Latching

| Electrical Data | | | | Mechanical Data | | | Grade 1[1] | | | Grade 2[2] | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Contact Rating at 28 vdc Resistive[3] (amps) | Coil Voltage Nominal (vdc) | Coil Voltage Pull-in (max) (vdc) | Nominal dc Coil Resistance (ohms) | Contact Form[4] | Package Type | Terminal Type | GSFC Part Number | Specification GSFC-S-311-P-2(06) | Mfr. | MIL Part Number | Specification[5] | Mfr. | |
| 1.0[6] | 26.5<br>18.0<br>12.0<br>9.0<br>6.0 | 18.0<br>13.5<br>9.0<br>6.8<br>4.5 | 2000<br>1130<br>500<br>280<br>120 | 2 Form C (2PDT) | TO-5 Can | Wire Leads | P2/33-01<br>P2/33-02<br>P2/33-03<br>P2/33-04<br>P2/33-05 | /33 | Teledyne | M39016/12-018P<br>M39016/12-017P<br>M39016/12-016P<br>M39016/12-015P<br>M39016/12-014P | MIL-R-39016/12 | QPL-39016 | |
| 1.0[6] | 26.5<br>18.0<br>12.0<br>9.0<br>6.0 | 18.0<br>13.5<br>9.0<br>6.8<br>4.5 | 2000<br>1130<br>500<br>280<br>120 | 2 Form C (2PDT) | TO-5 Can | Wire Leads | P-2/37-01<br>P-2/37-02<br>P-2/37-03<br>P-2/37-04<br>P-2/37-05 | /37 | Teledyne | M39016/29-018P<br>M39016/29-017P<br>M39016/29-016P<br>M39016/29-015P<br>M39016/29-014P | MIL-R-39016/29 | | Coil Transient Suppression |
| 2.0[6] | 24.0<br>12.0 | 18.0<br>6.8 | 1000<br>250 | 2 Form C (2 PDT) | 1/2 Crystal Can | Solder Hook | P2/50-01<br>P2/50-02 | 150 | Potter and Brumfield (AMF) | 8 | | | |
| | 24.0<br>12.0<br>24.0<br>12.0 | 18.0<br>6.8<br>18.0<br>6.8 | 1000<br>250<br>1000<br>250 | | | Pins | P2/50-03<br>P2/50-04<br>P2/50-05<br>P2/50-06 | | | | | | |
| 2.0[6] | 26.5 | 13.5 | 975 | 4 Form C (4PDT) | Low[7] Profile | Pins | P-2(06)/27-01 | /27 | GE | M39016/31-003M | MIL-R-39016/31 | | |
| 25.0 | 28.0 | 18.0 | 450 | 3 Form C (3PDT) | One Inch Cube | Solder Lugs | P-2(06)/35-01 | /35 | QPL-6106 (MS27742) | MS27742-1 | MIL-R-6106 | QPL-6106 | |
| | | | | | | Pins | P-2(06)/35-02 | | | MS27742-2 | | | |

NOTES:

1. Parts for flight use must be obtained with unpainted enclosures.
2. For ground support only. For flight applications, use Grade 1 Part.
3. For contact ratings for other types of loads (inductive, capacitive, lamp, motor), contact the Passive Devices Section.
4. Refer to MIL-R-39016 or the NARM Engineers Relay Handbook for definitions of forms (example: form C = single break, double throw, transfer, break before make).
5. These military specifications prescribe relaxed quality assurance provisions when compared with GSFC S-311-P-2(06), (see Grade 1 parts). For example, the GSFC specification requires 100% pre-cap visual inspection, whereas the military specifications do not.
6. Contracts also rated for low level applications.
7. 15.5mm x 15.5mm x 8.1mm high (.610" x .610" x .320").
8. Use Grade 1 parts (no other versions are available).

## Index of Preferred Resistors

| MIL Style | Description | Specification | Refer To |
|---|---|---|---|
| RBR | Wire wound, Presision, Accurate | MIL-R-39005 | MIL-STD-975 |
| RWR | Wire wound, Power | MIL-R-39007 | MIL-STD-975 |
| RCR | Composition | MIL-R-39008 | MIL-STD-975 |
| RER | Wire wound, Power, Chassis Mounted Non-Inductive and Inductive winding | MIL-R-39009 | MIL-STD-975 |
| RLR | Film, General Purpose | MIL-R-39017 | MIL-STD-975 |
| RTR | Wire wound, Variable | MIL-R-39015 | MIL-STD-975 |
| RJR | Non-wire wound, variable | MIL-R-39035 | MIL-STD-975 |
| RN(X)[1] | Film, High Stability | MIL-R-55182 | MIL-STD-975 |
| RZO | Fixed Film Networks | MIL-R-83401 | MIL-STD-975 |

NOTE:
1. GSFC does not consider type "C" terminal material to be readily weldable, and recommends using type "N" in welding applications. Type "C" and "R" may be used in soldering applications. Styles 75 and 90 are available only with type "C" terminal material.

# Index of Preferred Diodes

| Grade 1[1] Type Designation JANS | Grade 2 Type Designation JANTXV[2] | Function | Refer To |
|---|---|---|---|
| Type No. | | | |
| 1N645-1<br>1N647-1<br>1N649-1 | | Small Signal | MIL-STD-975 |
| 1N746A-1<br>thru<br>1N759A,-1 | | Zener Voltage Regulator | |
| 1N821-1<br>1N823,-1<br>1N825-1<br>1N827,-1<br>1N829,-1<br>1N935B | | Voltage Reference | Page 08-3<br>MIL-STD-975<br>Page 08-3<br>MIL-STD-975<br>Page 08-3 |
| 1N937B<br>thru<br>1N940B | | Zener Voltage Reference | MIL-STD-975 |
| 1N941B<br>1N943B<br>1N944B<br>1N945B | | Voltage Reference | Page 08-3 |
| 1N962B<br>thru<br>1N992B<br>1N962B-1<br>thru<br>1N978B-1 | | Zener Voltage Regulator | MIL-STD-975 |
| [3]TX1N1202A | | Power Rectifier | |
| 1N2970B<br>thru<br>1N3051B | | Zener Voltage Regulator | |
| 1N3595<br>1N3600 | | Switching | Page 08-2 |
| 1N3821A<br>thru<br>1N3828A | | Voltage Regulator | MIL-STD-975 |
| 1N3891<br>1N3893 | | Fast Switching Power Rectifier | |
| 1N4099<br>thru<br>1N4135 | | Voltage Regulator | Page 08-4 |
| 1N4148-1 | | Small Signal | MIL-STD-975 |
| 1N4150-1<br>1N4153-1 | | Switching | Page 08-2 |

| Grade 1[1] Type Designation JANS | Grade 2 Type Designation JANTXV[2] | Function | Refer To |
|---|---|---|---|
| Type No. | | | |
| 1N4245<br>1N4247<br>1N4249 | | Power<br>Power | Page 08-7 |
| 1N4306<br>1N4307 | | Switching | Page 08-2 |
| 1N4370A-1<br>thru<br>1N4372A-1 | | Voltage Regulator | MIL-STD-975 |
| 1N4454-1 | | Switching | Page 08-2 |
| 1N4460<br>thru<br>1N4496 | | Zener Voltage Regulator | MIL-STD-975 |
| 1N4531<br>1N4532 | | Switching | Page 08-2 |
| 1N4465A<br>thru<br>1N4569A | | Voltage Reference | Page 08-3 |
| 1N4570A<br>thru<br>1N4574A | | Zener Voltage Reference | MIL-STD-975 |
| 1N4614<br>thru<br>1N4627 | | Voltage Regulator | Page 08-5 |
| 1N4942<br>1N4944<br>1N4946<br>1N4947<br>1N4948 | | Fast Switching Power Rectifier | Page 08-6 |
| 1N4954<br>thru<br>1N4996 | | Voltage Regulator | MIL-STD-975 |
| 1N5139A<br>thru<br>1N5148A | | Voltage Variable Capacitor | Page 08-7 |
| 1N5285<br>thru<br>1N5314 | | Current Regulator | MIL-STD-975 |
| 1N5415<br>thru<br>1N5420 | | Fast Switching Power Rectifier | |
| 1N5550<br>thru<br>1N5554<br>1N5614 | | Power Rectifier | |

| Grade 1[1] Type Designation JANS | Grade 2 Type Designation JANTXV[2] | Function | Refer To |
|---|---|---|---|
| Type No. | | | |
| 1N5615 | | Fast Switching Power Rectifier | MIL-STD-975 |
| 1N5616 | | Power Rectifier | |
| 1N5617 | | Fast Switching Power Rectifier | |
| 1N5618 | | Power Rectifier | |
| 1N5619 | | Fast Switching Power Rectifier | |
| 1N5620 | | Power Rectifier | |
| 1N5621 | | Fast Switching Power Rectifier | |
| 1N5622 | | Power Rectifier | |
| 1N5623 | | Fast Switching Power Rectifier | |
| 1N5629A<br>thru<br>1N5665A | | Zener Voltage Suppressor | |
| 1N5711<br>1N5712 | | Schottky Barrier Switching | |
| [3]TX1N5719 | | PIN Switching | |
| [3]TX1N5765 | | LED | |
| 1N5768<br>1N5770<br>1N5772<br>1N5774 | | Array | |
| 1N5814<br>1N5816 | | Power Rectifier | |
| [3]TX1N5829<br>[3]TX1N5830<br>[3]TX1N5831 | | Schottky Barrier Rectifier | |
| 1N5907 | | Zener Voltage Suppressor | |
| 1N6073<br>thru<br>1N6081 | | Fast Switching Power Rectifier | Page 08-6 |
| [3]TX1N6092<br>[3]TX1N6093<br>[3]TX1N6094 | | LED | MIL-STD-975 |
| 1N6102,A<br>thru<br>1N6173,A | | Transient Voltage Suppressor | |
| 2N2322A<br>2N2324A<br>2N2326A<br>2N2328A | | SCR | |

NOTES:

1. When no Grade 1 diode is available, a Grade 2 diode may be upgraded for use in Grade 1 applications in accordance with Appendix A.
2. JANTXV diodes must be rescreened in accordance with the applicable TX detail specification of MIL-S-19500 for use in Grade 2 applications.
3. This device is not available as JANS or JANTXV and is considered to be a NON-STANDARD part by GSFC.

# DIODES
## Switching, Silicon[1]

| Grade 1[2] Type Designation JANS | Grade 2 Type Designation JANTXV[3] | Specification MIL-S-19500 | Manufacturer | Maximum Forward Voltage (Vdc) | @ Forward Current (mAdc) | Maximum Reverse Current (μAdc) | @ Reverse Voltage (Vdc) | Reverse Recovery Time ($t_{rr}$) (nsec) | Capacitance (pF) | Case Dwg. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1N3595 | | /241 | QPL-19500 | 0.88 | 50 | 0.001 | 125 | 3000 | 8.0 | 4 | |
| 1N3600 | | /231 | | 0.86 | 50 | 0.10 | 50 | 4 | 2.5 | | |
| 1N4150-1 | | | | 0.86 | 50 | 0.10 | 50 | | 2.5 | | |
| 1N4153-1 | | /337 | | 0.81 | 10 | 0.05 | 50 | | 2.0 | DO35 | |
| 1N4306 | | /278 | | 0.81 | 10 | 5.0 | 75 | | 2.0 | 4 lead flat pack 5 | Two matched discrete hermetically sealed diodes are encapsulated in a plastic module. |
| 1N4307 | | /284 | | 0.81 | 10 | 5.0 | 75 | | 2.0 | 8 lead flat pack 6 | Four matched discrete hermetically sealed diodes are encapsulated in a plastic module. |
| 1N4454-1 | | /144 | | 1.0 | 10 | 0.1 | 50 | 4 | 2.0 | DO35 | |
| 1N4531 | | /116 | | 1.0 | 10 | 5.0 | 75 | 5 | 4.0 | 4 | |
| 1N4532 | | /144 | | 1.0 | 10 | 0.1 | 50 | 4 | 2.0 | | |

NOTES:
1. See MIL-STD-975 for additional types.
2. See Note 1 on Page 08-1.
3. See Note 2 on Page 08-1.
4. This case does not meet the dimensional criteria for any JEDEC outline. See MIL-S-19500 detail specification for case outline dimensions.
5. 11.30 mm x 4.37 mm x 7.62 mm.
6. 11.30 mm x 4.37 mm x 12.45 mm.

# DIODES
## Voltage Reference, Silicon[1]

| Grade 1[2] Type Designation JANS | Grade 2 Type Designation JANTXV[3] | Specification MIL-S-19500 | Manufacturer | Reference Voltage (min/max) (Vdc) | @ Zener Current (mAdc) | Voltage Change (Vdc) | over Temperature Range | Impedance (ohms) | @ Zener Current (mAdc) | Case Dwg. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1N821-1 | | /159 | QPL-19500 | 5.90/6.50 | 7.5 | 0.096 | -55°C – 100°C | 15 | 7.5 | DO7 |
| 1N825-1 | | | | | | 0.019 | | | | |
| 1N935B | | /156 | | 8.55/9.45 | | 0.184 | -55°C – 150°C | 20 | | |
| 1N941B | | /157 | | 11.12/12.28 | | 0.239 | | 30 | | |
| 1N943B | | | | | | 0.047 | | | | |
| 1N944B | | | | | | 0.024 | | | | |
| 1N945B | | | | | | 0.012 | | | | |
| 1N4565A | | /452 | | 6.08/6.72 | 0.5 | 0.100 | -55°C – 100°C | 200 | 0.5 | |
| 1N4566A | | | | | | 0.050 | | | | |
| 1N4567A | | | | | | 0.020 | | | | |
| 1N4568A | | | | | | 0.010 | | | | |
| 1N4569A | | | | | | 0.005 | | | | |

NOTES:
1. See MIL-STD-975 for additional types.
2. See Note 1 on Page 08-1.
3. See Note 2 on Page 08-2.

## DIODES (Page 1 of 2)
### Voltage Regulator, Silicon[1]

| Grade 1[2] Type Designation JANS | Grade 2 Type Designation JAN[3] | Specification MIL-S-19500 | Manufacturer | Nominal Reference Voltage $V_Z$ (V) @ $I_Z$ (mA) | | Max. Impedance $Z_Z$ (Ohms) | Max. Diss. $T_A$ = 25°C (W) | Voltage Temp. Coefficient (%/°C) | Max. Temp. | Case Dwg. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1N4099 | | /435 | QPL-19500 | 6.8 | 56 | 200 | 0.40 | +0.060 | 175°C | D014 | Low Noise Devices |
| 1N4100 | | | | 7.5 | 51 | | | +0.065 | | | |
| 1N4101 | | | | 8.2 | 46 | | | +0.070 | | | |
| 1N4102 | | | | 8.7 | 44 | | | +0.075 | | | |
| 1N4103 | | | | 9.1 | 42 | | | +0.080 | | | |
| 1N4104 | | | | 10.0 | 38 | | | | | | |
| 1N4105 | | | | 11.0 | 35 | | | | | | |
| 1N4106 | | | | 12.0 | 32 | | | | | | |
| 1N4107 | | | | 13.0 | 29 | | | | | | |
| 1N4108 | | | | 14.0 | 27 | | | +0.085 | | | |
| 1N4109 | | | | 15.0 | 25 | 100 | | | | | |
| 1N4110 | | | | 16.0 | 24 | | | | | | |
| 1N4111 | | | | 17.0 | 22 | | | +0.090 | | | |
| 1N4112 | | | | 18.0 | 21 | | | | | | |
| 1N4113 | | | | 19.0 | 20 | 150 | | | | | |
| 1N4114 | | | | 20.0 | 19 | | | | | | |
| 1N4115 | | | | 22.0 | 17 | | | | | | |
| 1N4116 | | | | 24.0 | 16 | | | | | | |
| 1N4117 | | | | 25.0 | 15 | | | | | | |
| 1N4118 | | | | 27.0 | 14 | | | | | | |
| 1N4119 | | | | 28.0 | 14 | 200 | | +0.095 | | | |
| 1N4120 | | | | 30.0 | 13 | | | | | | |
| 1N4121 | | | | 33.0 | 12 | | | | | | |
| 1N4122 | | | | 36.0 | 11 | | | | | | |
| 1N4123 | | | | 39.0 | 9.8 | | | | | | |
| 1N4124 | | | | 43.0 | 8.9 | 250 | | | | | |
| 1N4125 | | | | 47.0 | 8.1 | | | | | | |
| 1N4126 | | | | 51.0 | 7.5 | 300 | | +0.100 | | | |
| 1N4127 | | | | 56.0 | 6.7 | | | | | | |
| 1N4128 | | | | 60.0 | 6.4 | 400 | | | | | |
| 1N4129 | | | | 62.0 | 6.1 | 500 | | | | | |
| 1N4130 | | | | 68.0 | 5.6 | 700 | | | | | |
| 1N4131 | | | | 75.0 | 5.1 | | | | | | |
| 1N4132 | | | | 82.0 | 4.6 | 800 | | | | | |
| 1N4133 | | | | 87.0 | 4.4 | 1000 | | | | | |
| 1N4134 | | | | 91.0 | 4.2 | 1200 | | | | | |
| 1N4135 | | | | 100.0 | 3.8 | 1500 | | | | | |

NOTES:
1. See MIL-STD-975 for additional types.
2. See Note 1 on Page 08-1.
3. See Note 2 on Page 08-2.

## DIODES (Page 2 of 2)
## Voltage Regulator, Silicon[1]

| Grade 1[2] Type Designation JANS | Grade 2 Type Designation JANTXV[3] | Specification MIL-S-19500 | Manufacturer | Nominal Reference Voltage $V_Z$ (V) @ $I_Z$ (mA) | | Max. Impedance $Z_Z$ (Ohms) | Max. Diss. $T_A$ = 25°C (W) | Voltage Temp. Coefficient (%/°C) | Max. Temp. | Case Dwg. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1N4614 | | /435 | QPL-19500 | 1.8 | 212 | 1200 | 0.040 | -0.075 | 175°C | D014 | Low Noise Devices |
| 1N4615 | | | | 2.0 | 190 | 1250 | | | | | |
| 1N4616 | | | | 2.2 | 173 | 1300 | | | | | |
| 1N4617 | | | | 2.4 | 159 | 1400 | | | | | |
| 1N4618 | | | | 2.7 | 141 | 1500 | | | | | |
| 1N4619 | | | | 3.0 | 127 | 1600 | | | | | |
| 1N4620 | | | | 3.3 | 116 | 1650 | | | | | |
| 1N4621 | | | | 3.6 | 106 | 1700 | | -0.065 | | | |
| 1N4622 | | | | 3.9 | 98 | 1650 | | -0.060 | | | |
| 1N4623 | | | | 4.3 | 87 | 1600 | | -0.050 | | | |
| 1N4624 | | | | 4.7 | 81 | 1550 | | -0.040/+0.020 | | | |
| 1N4625 | | | | 5.1 | 75 | 1500 | | -0.045/+0.030 | | | |
| 1N4626 | | | | 5.6 | 68 | 1400 | | -0.020/+0.040 | | | |
| 1N4627 | | | | 6.2 | 61 | 1200 | | -0.010/+0.050 | | | |

NOTES:
1. See MIL-STD-975 for additional types.
2. See Note 1 on Page 08-1.
3. See Note 2 on Page 08-2.

## DIODES

### Power Rectifiers, Fast Switching, Silicon[1]

| Grade 1[2] Type Designation JANS | Grade 2 Type Designation JANTXV[3] | Specification MIL-S-19500 | Manufacturer | $I_O$ (Adc) | | $V_{RM}$ (wkg) [V (pk)] | Reverse Recovery Time ($t_{rr}$) (nsec) | Maximum Reverse Current ($\mu$Adc) @ | Reverse Voltage (Vdc) | $I_{FSM}$ (1/120 sec) (A pk) | Case Dwg. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1N3891 | | /304 | | 12 | @$T_C$ = 100°C | 200 | 200 | 25 | 200 | 150 | DO4 |
| 1N4942 | | /359 | | 1.0 | @$T_A$ = 55°C | 200 | 150 | 1.0 | 200 | 10 | DO15 |
| 1N4944 | | | | | | 400 | 150 | | 400 | | |
| 1N4946 | | | | | | 600 | 150 | | 600 | | |
| 1N4947 | | | | | | 800 | 250 | | 800 | 15 | |
| 1N4948 | | | | | | 1000 | 500 | | 1000 | 10 | |
| 1N5816 | | /478 | | 20 | @$T_C$ = 100°C | 150 | 35 | 10.0 | 150 | 400 | DO4 |
| 1N6073 | | /503 | QPL-19500 | 0.85 | @$T_A$ = 55°C | 50 | 30 | 1.0 | 50 | 35 | 4 |
| 1N6074 | | | | | | 100 | | | 100 | | |
| 1N6075 | | | | | | 150 | | | 150 | | |
| 1N6076 | | | | 1.3 | | 50 | | 5.0 | 50 | 75 | |
| 1N6077 | | | | | | 100 | | | 100 | | |
| 1N6078 | | | | | | 150 | | | 150 | | |
| 1N6079 | | | | 2.0 | | 50 | | 10.0 | 50 | 175 | |
| 1N6080 | | | | | | 100 | | | 100 | | |
| 1N6081 | | | | | | 150 | | | 150 | | |

NOTES:
1. See MIL-STD-975 for additional types.
2. See Note 1 on Page 08-1.
3. See Note 2 on Page 08-2.
4. This case does not meet the dimensional criteria for any JEDEC outline. See MIL-S-19500 detail specification for case outline dimensions.

## DIODES
## Power, Silicon[1]

| Grade 1[2] Type Designation JANS | Grade 2 Type Designation JANTXV[3] | Specification MIL-S-19500 | Manufacturer | Maximum Forward Voltage [V (pk)] | Forward Current [A (pk)] | Maximum Reverse Current 25°C (μAdc) | @ 150°C (mAdc) | @ Reverse Voltage (Vdc) | Reverse Recovery Time $t_{rr}$ (μsec) | Case Dwg. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1N4245 | | /286 | QPL-19500 | 1.3 | 3.0 | 1.0 | .15 | 200 | 5 | DO15 |
| 1N4247 | | | | | | | | 600 | | |
| 1N4249 | | | | | | | | 1000 | | |

## DIODES
## Voltage Variable Capacitor, Silicon

| Grade 1[2] Type Designation JANS | Grade 2 Type Designation JANTXV[3] | Specification MIL-S-19500 | Manufacturer | Nominal Cap. @$V_R$ = 4Vdc (pF) | Cap. Ratio $V_T$ = 4v to 60v (times) | Max. Cont. Work. Volts $V_R$ (volts) | Min. Q @f = 50MHz $V_R$ = 4vdc | Max. Diss. (W) | Max. Temp. (°C) | Case Dwg. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1N5139A | | /383 | QPL-19500 | 6.8 | 2.7 | 60 | 350 | 0.4 | 175°C | DO7 |
| 1N5140A | | | | 10 | 2.8 | | 300 | | | |
| 1N5141A | | | | 12 | | | | | | |
| 1N5142A | | | | 15 | | | 250 | | | |
| 1N5143A | | | | 18 | | | | | | |
| 1N5144A | | | | 22 | 3.2 | | 200 | | | |
| 1N5145A | | | | 27 | | | | | | |
| 1N5146A | | | | 33 | | | | | | |
| 1N5147A | | | | 39 | | | | | | |
| 1N5148A | | | | 47 | | | | | | |

NOTES: 1. See MIL-STD-975 for additional types.
2. See Note 1 on Page 08-1.
3. See Note 2 on Page 08-2.

# Index of Preferred Transisters

| Grade 1[1] JANS Type No. | Grade 2 JANTXV[2] Type No. | Function | Refer To |
|---|---|---|---|
| G3000<br>G3001<br>G3005 | | Microwave, Power | Page 09-[3] |
| | 2N718A | Low Power — NPN | Page 09-2 |
| | 2N918 | RF — NPN | MIL-STD-975 |
| | 2N1613 | Medium Power — NPN | Page 09-3 |
| | 2N2060 | Dual — NPN | MIL-STD-975 |
| | 2N2219A | Medium Power — NPN | |
| | 2N2222A | Lower Power — NPN | |
| | 2N2369A | | |
| | 2N2432A | Chopper — NPN | |
| | 2N2484 | Low Power — NPN | |
| | 2N2605 | Low Power — PNP | |
| | 2N2657 | RF — NPN | Page 09-6 |
| | 2N2880 | High Power — NPN | Page 09-4 |
| | 2N2905A | Medium Power — PNP | MIL-STD-975 |
| | 2N2907A | Low Power — PNP | |
| | 2N2920 | Dual — NPN | Page 09-3 |
| | 2N2944A | Chopper — PNP | MIL-STD-975 |
| | 2N2945A | | |
| | 2N2946A | | Page 09-3 |
| | 2N3019 | Medium Power — NPN | |

| Grade 1[1] JANS Type No. | Grade 2 JANTXV[2] Type No. | Function | Refer To |
|---|---|---|---|
| | 2N3251A | Low Power — PNP | Page 09-2 |
| | [3]TX2N3330 | J-FET (P-CH) | MIL-STD-975 |
| | 2N3375 | RF — NPN | Page 09-6 |
| | 2N3553 | RF — NPN | |
| | 2N3637 | Medium Power — PNP | MIL-STD-975 |
| | 2N3700 | Low Power — NPN | |
| | 2N3741 | High Power — PNP | Page 09-4 |
| | 2N3749 | High Power — NPN | MIL-STD-975 |
| | 2N3763 | Medium Power — PNP | Page 09-2 |
| | 2N3765 | Low Power — PNP | |
| | 2N3792 | High Power — PNP | Page 09-4 |
| | 2N3810 | Dual — PNP | MIL-STD-975 |
| | 2N3811 | Dual — PNP | |
| | 2N3821 | J-FET (N-CH) | Page 09-5 |
| | 2N3822 | | |
| | 2N3823 | | MIL-STD-975 |
| | 2N3866 | RF — NPN | Page 09-6 |
| | 2N3868 | Medium Power — PNP | Page 09-2 |
| | 2N3995 | High Power — NPN | MIL-STD-975 |
| | 2N4150 | Medium Power — NPN | |
| | 2N4399 | High Power — PNP | |
| | 2N4440 | RF — NPN | Page 09-6 |

| Grade 1[1] JANS Type No. | Grade 2 JANTXV[2] Type No. | Function | Refer To |
|---|---|---|---|
| | 2N4856 | J-FET (N-CH) | MIL-STD-975 |
| | 2N4857 | | Page 09-5 |
| | 2N4858 | | |
| | 2N4931 | Medium Power — PNP | Page 09-2 |
| | 2N4948 | Unijunction | MIL-STD-975 |
| | 2N4957 | RF — PNP | |
| | 2N5038 | High Power — NPN | Page 09-4 |
| | 2N5114 | J-FET (P-CH) | MIL-STD-975 |
| | 2N5250 | High Power — NPN | Page 09-4 |
| | 2N5416 | Low Power — PNP | MIL-STD-975 |
| | 2N5680 | High Power — NPN | Page 09-4 |
| | 2N5662 | Medium Power — NPN | Page 09-3 |
| | 2N5666 | High Power — NPN | MIL-STD-975 |
| | 2N5667 | High Power — NPN | |
| | 2N5572 | High Power — NPN | |
| | 2N5745 | High Power — PNP | Page 09-4 |
| | 2N6308 | High Power — NPN | MIL-STD-975 |
| | 4N23 | Photocoupler | |
| | 4N23A | | |
| | 4N24 | | |
| | 4N24A | | |

NOTES:
1. When no Grade 1 transistor is available, a Grade 2 transistor may be upgraded for use in Grade 1 applications in accordance with Appendix A.
2. JANTXV transistors must be rescreened in accordance with the applicable TX detail specification of MIL-S-19500, for use in Grade 2 applications.
3. This device is not available as JANS or JANTXV and is considered to be a NON-STANDARD part by GSFC.

## TRANSISTORS
### NPN, Silicon, Low Power[1]

| Grade 1[2] Type Designation JANS | Grade 2 Type Designation JANTXV[3] | Specification MIL-S-19500 | Manufacturer | $h_{FE}$ (min/max) | @ $I_C$ (mAdc) | @ $V_{CE}$ (Vdc) | $I_{CBO}$ (nAdc) | @ $V_{CB}$ (Vdc) | $V_{CE}$(SAT) (Vdc) | @ $I_C$ (mAdc) | @ $I_B$ (mAdc) | $BV_{CBO}$ (Vdc) | $P_T$ @$T_A$ = 298K (mW) | Case Dwg. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2N718A | | /181 | QPL-19500 | 40/120 | 150 | 10 | 10 | 60 | 1.5 | 150 | 15 | 75 | 500 | TO18 |

## TRANSISTORS
### PNP, Silicon, Low Power[1]

| Grade 1[2] Type Designation JANS | Grade 2 Type Designation JANTXV[3] | Specification MIL-S-19500 | Manufacturer | $h_{FE}$ (min/max) | @ $I_C$ (mAdc) | @ $V_{CE}$ (Vdc) | $I_{CBO}$ (nAdc) | @ $V_{CB}$ (Vdc) | $V_{CE}$(SAT) (Vdc) | @ $I_C$ (mAdc) | @ $I_B$ (mAdc) | $BV_{CBO}$ (Vdc) | $P_T$ @$T_A$ = 298K (mW) | Switching Time $t_{on}$ (nsec) | Switching Time $t_{off}$ (nsec) | Case Dwg. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2N3251A | | /323 | QPL-19500 | 100/300 | -10 | -1 | -20 | -40 | -0.25 | -10 | -1 | -60 | 360 | 70 | 250 | TO18 |
| 2N3765 | | /396 | | 40/140 | -500 | -1 | -100 | -30 | -0.5 | -500 | -50 | | 500 | 43 | 115 | TO46 |

## TRANSISTORS
### PNP, Silicon, Medium Power[1]

| Grade 1[2] Type Designation JANS | Grade 2 Type Designation JANTXV[3] | Specification MIL-S-19500 | Manufacturer | $h_{FE}$ (min/max) | @ $I_C$ (mAdc) | @ $V_{CE}$ (Vdc) | $I_{CBO}$ (nAdc) | @ $V_{CE}$ (Vdc) | $V_{CE}$(SAT) (Vdc) | @ $I_C$ (mAdc) | @ $I_B$ (mAdc) | $BV_{CBO}$ (Vdc) | $P_T$ @$T_A$ = 298K (mW) | Switching Time $t_{on}$ (nsec) | Switching Time $t_{off}$ (nsec) | Case Dwg. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2N3763 | | /396 | QPL-19500 | 40/140 | -500 | -1 | -100 | -30 | -0.5 | -500 | -50 | -60 | 1000 | 43 | 115 | TO5 |
| • 2N3868 | | /350 | | 30/150 | -1500 | -2 | $I_{CEX}$ = -1000 | $V_{CE}$ = -60Vdc | | | | | | 100 | 600 | |
| 2N4931 | | /397 | | 50/200 | -30 | -10 | -500 | -200 | -1.2 | -30 | -3 | -250 | | not specified | | TO39 |

NOTES:
1. See MIL-STD-975 for additional types.
2. See Note 1 on Page 09-1.
3. See Note 2 on Page 09-1.

## TRANSISTORS
### NPN, Silicon, Medium Power[1]

| Grade 1[2] Type Designation JANS | Grade 2 Type Designation JANTXV[3] | Specification MIL-S-19500 | Manufacturer | $h_{FE}$ (min/max) @ $I_C$ (mAdc) | @ $V_{CE}$ (Vdc) | $I_{CBO}$ (nAdc) @ $V_{CB}$ (Vdc) | | $V_{CE}$(SAT) (Vdc) @ $I_C$ (mAdc) | @ $I_B$ (mAdc) | $BV_{CBO}$ (Vdc) | $P_T$ @$T_A$ = 298K (mW) | Switching Time $t_{on}$ (nsec) | $t_{off}$ (nsec) | Case Dwg. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2N1613 | | /181 | QPL-19500 | 40/120 | 150 | 10 | 10 | 60 | 1.5 | 150 | 15 | 75 | 800 | not specified | | TO5 |
| 2N3019 | | /391 | | 100/300 | 150 | 10 | $I_{CES}$ = 10nAdc | $V_{CE}$ = 90Vdc | 0.2 | 150 | 15 | 140 | | | | |
| 2N5662 | | /454 | | 40/120 | 500 | 5 | 100 | 200 | 0.4 | 1000 | 100 | 250 | 1200 | 250 | 850 | |

## TRANSISTORS
### PNP, Chopper, Low Power, Silicon[1]

| Grade 1[2] Type Designation JANS | Grade 2 Type Designation JANTXV[3] | Specification MIL-S-19500 | Manufacture | $h_{FE}$ (min) @ $I_C$ (mAdc) | @ $V_{CE}$ (Vdc) | $r_{ec}$ (on) (max) (Ohms) @ f = 1kHz $I_E$ = 0 and $I_B$ (mAdc) | $I_e$ ($\mu$A) | $V_{EC}$(ofs) (max) (Vdc) @ $I_E$ (mAdc) | $I_B$ (mAdc) | $BV_{CBO}$ (Vdc) | $P_T$ @$T_A$ = 298K (mW) | Case Dwg. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2N2944A | | /382 | QPL-19500 | 100 | -1 | -0.5 | 4 | -1 | 100 | -0.6 | 0 | -1 | -15 | 400 | TO46 |
| 2N2946A | | | | 50 | | | 8 | | | -2.0 | | | -40 | | |

NOTES:
1. See MIL-STD-975 for additional types.
2. See Note 1 on Page 09-1.
3. See Note 2 on Page 09-1.

## TRANSISTORS
### NPN, Silicon, High Power[1]

| Grade 1[2] Type Designation JANS | Grade 2 Type Designation JANTXV[3] | Specification MIL-S-19500 | Manufacturer | $h_{FE}$ (min/max) | @ $I_C$ (Adc) | @ $V_{CE}$ (Vdc) | $I_{CBO}$ (mAdc) | @ $V_{CB}$ (Vdc) | $V_{CE}$(SAT) (Vdc) | @ $I_C$ (Adc) | @ $I_B$ (Adc) | $BV_{CBO}$ (Vdc) | $P_T$ @$T_C$ = 298K (Watts) | Case Dwg. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2N2880 | | /315 | QPL-19500 | 40/120 | 1 | 5 | 0.0004 | 80 | 0.25 | 1 | 0.1 | 110 | 30@ $T_C$ = 373K | 4 |
| 2N5038 | | /439 | | 50/200 | 2 | 5 | 25 | 150 | 1.0 | 12 | 1.2 | 150 | 140 | TO3 |
| 2N5250 | | /380 | | 30/90 | 20 | 5 | $I_{CES}$ = 0.1mAdc | $V_{CE}$ = 125Vdc | 1.0 | 40 | 4 | 125 | 350 | 4 |
| 2N5660 | | /454 | | 40/120 | 0.5 | 5 | 0.0001 | 200 | 0.4 | 1 | 0.1 | 250 | 20@ $T_C$ = 373K | TO66 |

## TRANSISTORS
### PNP, Silicon, High Power[1]

| Grade 1[2] Type Designation JANS | Grade 2 Type Designation JANTXV[3] | Specification MIL-S-19500 | Manufacturer | $h_{FE}$ (min/max) | @ $I_C$ (Adc) | @ $V_{CE}$ (Vdc) | $I_{CBO}$ (mAdc) | @ $V_{CB}$ (Vdc) | $V_{CE}$(SAT) (Vdc) | @ $I_C$ (Adc) | @ $I_B$ (Adc) | $BV_{CBO}$ (Vdc) | $P_T$ @$T_C$ = 298K (Watts) | Switching Time $t_{on}$ ($\mu$ sec) | Switching Time $t_{off}$ ($\mu$ sec) | Case Dwg. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2N3741 | | /441 | QPL-19500 | 30/100 | -0.250 | -1 | -0.0001 | -80 | -0.6 | -1 | -0.125 | -80 | 25 | 0.4 | 1.0 | TO66 |
| 2N3792 | | /379 | | 50/150 | -1 | -2 | $I_{CES}$ = -1mAdc | $V_{CE}$ = -70Vdc | -1 | -5 | -0.5 | | 150 | 1.5 | 2.0 | TO3 |
| 2N5745 | | /433 | | 15/60 | -10 | -2 | -1 | -80 | -1 | -10 | -1 | | 200 | 1.0 | 3.0 | |

NOTES:
1. See MIL-STD-975 for additional types.
2. See Note 1 on Page 09-1.
3. See Note 2 on Page 09-1.
4. This case does not meet the dimensional criteria for any JEDEC outline. See MIL-S-19500 detail specification for case outline dimensions.

## TRANSISTORS
## Field-Effect, N-Channel, Junction, Silicon[1]

| Grade 1[2] Type Designation JANS | Grade 2 Type Designation JANTXV[3] | Specification MIL-S-19500 | Manufacturer | $V_{DG}$ and $V_{DS}$ (max) (Vdc) | $V_{GS}$ (max) (Vdc) | $I_G$ (mA) | $V_{GS(off)}$ max. (Vdc) | @ $V_{DS}$ (Vdc) | @ $I_D$ (nA) | $I_{DSS}$ (min/max) (mA) | @ $V_{DS}$ (Vdc) | @ $V_{GS}$ (Vdc) | $P_T$ (mW) | Case Dwg. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2N3821 | | /375 | QPL-19500 | 50 | -50 | 10 | -4 | 15 | 0.5 | 0.5/2.5 | 15 | 0 | 300 | TO72 |
| 2N3822 | | | | | | | -6 | | | 2/10 | | | | |
| 2N4857 | | /385 | | 40 | -40 | 50 | | | | 20/100 | | | 360 | TO18 |
| 2N4858 | | | | | | | -4 | | | 8/80 | | | | |

NOTES:
1. See MIL-STD-975 for additional types.
2. See Note 1 on Page 09-1.
3. See Note 2 on Page 09-1.

# TRANSISTORS
## RF, NPN, Silicon[1]

| Grade 1[2] Type Designation JANS | Grade 2 Type Designation JANTXV[3] | Specification | Manufacturer | $h_{FE}$ (min/max) | @ $I_C$ (mAdc) | @ $V_{CE}$ (Vdc) | $BV_{CBO}$ (Volts) | $P_{OUT}$ (min/max) (Watts) | @ $P_{IN}$ (Watts) | @ f (MHz) | @ $\eta$ (%) | $P_T$ $T_C$ = 298K (Watts) | Case Dwg. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| G3000[4] | | GSFC S-311-35 | Microwave Semiconductor Corp. | 15/120 | 100 | 5 | 50 | $G_{PB}$ = 11.0db min. | | 2250 | | Not Specified[5] | Microwave Pkg. |
| G3001[4] | | GSFC S-311-36 | | | | | | $G_{PB}$ = 10.8db min. | | | | | |
| G3005[4] | | GSFC S-311-37 | | | | | | $G_{PB}$ = 8.0db min. | | | | | |
| 2N2857 | | MIL-S-19500 /343 | QPL-19500 | 30/150 | 3 | 1 | 30 | $G_{PB}$ = 12.5/21db | | 450 | | 0.3 | TO72 |
| 2N3375 | | MIL-S-19500 /341 | | 15/150 | 150 | 5 | 65 | 7.5/14<br>3/6 | 1<br>1 | 100<br>400 | 65<br>40 | 11.6 | TO60 |
| 2N3553 | | | | | | | | 2.5/5 | 0.25 | 175 | 50 | 7.0 | TO39 |
| 2N3866 | | MIL-S-19500 /398 | | 15/200 | 50 | | 60 | 1/2<br>0.5 min. | 0.15<br>0.075 | 400<br>400 | 45<br>40 | 1.0 @ $T_A$ = 298K | |
| 2N4440 | | MIL-S-19500 /341 | | | | | | 10/16<br>4/8 | 1<br>1 | 100<br>400 | 65<br>40 | 11.6 | TO60 |

NOTES:
1. See MIL-STD-975 for additional types.
2. See Note 1 on Page 09-1.
3. See Note 2 on Page 09-1.
4. This is a Grade 1 device.
5. Power dissipation is determined by the type of heat sink used with the device.

# INDEX TO PREFERRED MICROCIRCUITS[1,2,3]

**LINEAR**

Operational Amplifier
- LM101A
- LM108A
- LM118
- LM741
- LM747

Voltage Regulator
- LM140K05
- LM140K12
- LM140K15
- LM140K24
- LM723

Voltage Comparators
- LM106
- LM111
- LM139
- LM710
- LM711

Line Driver
- 9614
- 55113

Line Receiver
- 9615
- 55107
- 55108

Precision Timer
- 555
- 556

**DIGITAL**

Low Power Schottky, TTL

| | | | |
|---|---|---|---|
| 54LS00 | 54LS32 | 54LS107 | 54LS174 |
| 54LS02 | 54LS37 | 54LS109 | 54LS175 |
| 54LS03 | 54LS38 | 54LS112 | 54LS181 |
| 54LS04 | 54LS40 | 54LS113 | 54LS191 |
| 54LS05 | 54LS42 | 54LS114 | 54LS194 |
| 54LS08 | 54LS47 | 54LS123 | 54LS195 |
| 54LS10 | 54LS51 | 54LS125 | 54LS240 |
| 54LS11 | 54LS54 | 54LS126 | 54LS241 |
| 54LS12 | 54LS73 | 54LS132 | 54LS251 |
| 54LS13 | 54LS74 | 54LS138 | 54LS253 |
| 54LS14 | 54LS76 | 54LS139 | 54LS257 |
| 54LS15 | 54LS83A | 54LS151 | 54LS258 |
| 54LS20 | 54LS85 | 54LS153 | 54LS266 |
| 54LS21 | 54LS86 | 54LS157 | 54LS283 |
| 54LS22 | 54LS90 | 54LS158 | 54LS295 |
| 54LS26 | 54LS92 | 54LS160 | 54LS365 |
| 54LS27 | 54LS93 | 54LS161 | 54LS367 |
| 54LS28 | 54LS95 | 54LS162 | 54LS368 |
| 54LS30 | 54LS96 | 54LS164 | 54LS395 |

TTL

| | | | |
|---|---|---|---|
| 5401 | 5425 | 5470 | 54145 |
| 5406 | 5443 | 5472 | 54150 |
| 5407 | 5444 | 5477 | 54154 |
| 5409 | 5448 | 5482 | 54163 |
| 5416 | 5449 | 54121 | 54165 |
| 5423 | 5450 | 54126 | |

Low Power TTL
- 54L71
- 54L72
- 54L78

**DIGITAL**

CMOS

| | | | |
|---|---|---|---|
| 4000A | 4015A | 4031A | 4081B |
| 4001A | 4017A | 4040A | 4082B |
| 4002A | 4018A | 4050A | 4085B |
| 4006A | 4019A | 4069UB | 4086B |
| 4007A | 4020A | 4070B | 4093B |
| 4009A | 4021A | 4071B | 4098B |
| 4010A | 4022A | 4072B | 4099B |
| 4011A | 4023A | 4073B | 40106B |
| 4012A | 4024A | 4075B | 40174B |
| 4013A | 4025A | 4076B | 4502B |
| 4014A | 4027A | 4077B | 4532B |
| | | | 4556B |

MEMORY

RAM

| | | | |
|---|---|---|---|
| 1821 | 4050 | 93L415 | |
| 1822 | 4060 | 93L425 | |

ROM
- 1834

PROM

| | | | |
|---|---|---|---|
| 82S126 | 82S130 | 82S137 | 82S185 |
| 82S129 | 82S131 | 82S181 | 82S191 |

MICROPROCESSOR

| | | |
|---|---|---|
| 1802 | 2901A | 2918 |
| 1852 | 2906 | 8080 |
| 1853 | 2916 | 8212 |

Notes:
1. MIL-STD-975C lists all of the preferred microcircuits; no additional types are listed in this PPL.
2. When no Grade 1 microcircuit is available, a Grade 2 microcircuit may be upgraded for use in Grade 1 applications in accordance with Appendix A.
3. See page 10-2 for additional information.

# MICROCIRCUIT INFORMATION

## HYBRID MICROCIRCUITS

Hybrid microcircuits are defined as parts which are comprised of any one of a combination of the following: multiple semiconductor chips (integrated circuits and/or discrete diodes or transistors), thin or thick films, and discrete passive elements. Since many processing techniques for hybrids are similar to those for monolithic microcircuitry, similar precautions and procedures for their procurement should be observed. Hybrid microcircuits by their nature tend to be low volume non-standard parts. Procedural guidelines for the procurement of nonstandard hybrid and monolithic microcircuits are given in the following paragraph.

## MONOLITHIC AND HYBRID MICROCIRCUITS NOT LISTED

For various types of monolithic and hybrid microcircuits not included in MIL–STD–975 and this PPL, the following procedures are suggested as a consequence of problems commonly referred to the GSFC Parts Branch:

1. A survey of the manufacturer's hybrid or IC microcircuit facility should be performed.
2. Since hybrid circuits may contain critical circuit assemblies approaching subsystems in complexity and function, a design review, including parts stress analysis is advised.
3. A sample quantity of each microcircuit order should be subjected to evaluation tests and internal inspection (Construction Analysis). Monolithic microcircuits shall be screened in accordance with MIL–STD–883, Method 5004, to the required screening level outlined in Appendix C.
4. Procurement specifications for hybrid microcircuits shall require qualification, lot acceptance, and screening to assure that the discrete parts used within hybrids are selected and screened with the same care as for monolithic microcircuits. For procurement and product assurance guidelines for hybrid microcircuits, consult the GSFC Specification for Hybrid Microcircuit Requirements, S-311-74 Rev. A., and your project parts engineer.
5. Environmental test levels for both monolithic and hybrid microcircuits shall be tailored to the processing techniques so as not to produce overstress.

## Solder, Rosin Core

| Type No.[1,2] | Approx. Gauge (AWG) | Tin Content (%) | Lead Content (%) | Antimony Content (%) | Max. Total Other Constituents Content (%) | Approx. Melting Range °C | | Specification | Manufacturer |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Solidus | Liquidus | | |
| SN60WRMAP<br>SN60WRP<br>SN60WRAP | 16, 18, 20 | 59.5-61.5 | 39.8 – 37.5 | 0.20-0.50 | 0.47 | 182 | 190 | QQ-S-571 | Per QPL-QQ-S-571 |
| SN63WRMAP<br>SN63WRP<br>SN63WRAP | 16, 18, 20 | 62.5-63.5 | 36.8 – 35.5 | 0.20-0.50 | 0.47 | 182 | 182 | QQ-S-571 | Per QPL-QQ-S-571 |

NOTES:

1. As a guide the recommended order of use for these solders and fluxes and the procedure for cleaning after soldering is as follows:
   (a) Type RMA flux is suitable for all electronic applications. (RMA is rosin core/mildly activated)
   (b) Type R may be used in critical applications such as in extremely low leakage circuits. A good joint may be more difficult to obtain with R than with type RMA. (R is rosin core/non-activated)
   (c) Type RA may be used when a joint cannot be made with RMA or R. (RA is rosin core/activated)
   (d) Cleaning requirements: All three fluxes, R, RMA, and RA must be cleaned with one of the solvents listed below after soldering:
      (1) Ethyl alcohol, ACS grade.
      (2) Isopropyl alcohol, ACS grade.
      (3) Trichlorotrifluoroethane, ACS grade.
      (4) Any mixture of these.
   (e) The degree of corrosiveness of the fluxes are as follows:
      R – least corrosive
      RMA – moderately corrosive
      RA – most corrosive
2. Refer to NASA publication NHB5300.4(3A-1), Requirements for Soldered Electrical Connections.

## Index of Preferred Thermistors

| Style | Description | Specification | Refer To |
|---|---|---|---|
| 311P18 | Thermisistor, Insulated, Negative Temp. Coeff. | S311-P-18(GSFC) | Page 14-1 |
| RTH | Thermisistor, Insulated, Positive Temp. Coeff. | MIL-T-23648 | MIL-STD-975 |

# THERMISTORS[1]
## (Temperature Sensitive Resistors)

| Temp. Coeff. | Resistance (ohms) | Tolerance at 25°C (±%) | Operating Temperature Range (°C) | Resistance Ratio $R_{25°C}/R_{MAX}$ | Grade 1 and Grade 2 | | |
|---|---|---|---|---|---|---|---|
| | | | | | Part Number[2] | Specification | Manufacturer |
| Neg. | 2252 | 1 | -55 to 90 | 10.93 | 311P18-02LXXX | GSFC S-311-P-18 | Yellow Springs Instrument |
| | 2252 | 0.5 | -55 to 70 | 5.71 | 311P18-02LXXX | | |
| | 3000 | 1 | -55 to 90 | 10.91 | 311P18-03LXXX | | |
| | 3000 | 0.5 | -55 to 70 | 5.71 | 311P18-04LXXX | | |
| | 5000 | 1 | -55 to 90 | 10.91 | 311P18-05LXXX | | |
| | 5000 | 0.5 | -55 to 70 | 5.71 | 311P18-06LXXX | | |
| | 10000 | 1 | -55 to 90 | 9.23 | 311P18-07LXXX | | |
| | 10000 | 0.5 | -55 to 70 | 5.03 | 311P18-08LXXX | | |
| | 30000 | 1 | -55 to 90 | 10.72 | 311P18-09LXXX | | |
| | 30000 | 0.5 | -55 to 70 | 5.60 | 311P18-10LXXX | | |

NOTES:
1. WARNING: Use heat sinks when soldering or welding to thermistor leads.
2. The complete part number is 311P18- AA L XXX

DASH NUMBER
(01, 02, etc.)

LEAD STYLE:
S = 32 AWG, Type C per MIL-STD-1276
T = 28 AWG, Type ET per MIL-W-16876
N = 32 AWG, Type N-2 per MIL-STD-1276
E = Insulated lead (TFE), 32 AWG per MIL-I-22129; Bare lead, Style S; Tubing (FEP), M23053/11-105c.

LEAD LENGTH:
Specify length in centimeters.
1R0 = 1.0, 10R = 10, 101 = 100.
Minimum length is 7.6cm.

## Index of Preferred Transformers

| MIL Style | Description | Specification | Refer To |
|---|---|---|---|
| M27/103 | Audio Frequency | MIL-T-27 | MIL-STD-975 |
| M27/165 | Audio Frequency | MIL-T-27 | MIL-STD-975 |
| M27/166 | Audio Frequency | MIL-T-27 | MIL-STD-975 |
| M27/197 | Audio Frequency | MIL-T-27 | MIL-STD-975 |
| M21038/9-005 | Pulse, Low Power | MIL-T-21038 | MIL-STD-975 |

## Index of Preferred Wire/Cable

| Style | Description | Specification | Refer To |
|---|---|---|---|
| M22759/11 and /9 | Wire, High temperature | MIL-W-22759 | Page 16-2 |
| M22759/18 | Wire, Light weight | MIL-W-22759 | Page 16-3 |
| S311P13 | Wire, High voltage | S-311-P-13(GSFC) | Page 16-4 |
| M22759/3/11/ 12/16/22/23 | Wire, Extruded TFE | MIL-W-22759 | MIL-STD-975 |
| M81381 | Wire, Fluorocarbon-Polymide | MIL-W-81381 | MIL-STD-975 |
| M16878 | Wire, High Temperature | MIL-W-16878 | MIL-STD-975 |
| M5086 | Wire, PVC insulated | MIL-W-5086 | MIL-STD-975 |
| M17 | Cable, RF, Flexible, Coaxial | MIL-C-17 | MIL-STD-975 |
| M27500 | Cable, Electrical, Shielded and Unshielded | MIL-C-27500 | MIL-STD-975 |

# WIRE
## Electrical, Insulated, High Temperature

| MIL Style[1] | Strands No. x AWG # | Diameter over Insulation, mm | | Voltage Rating, Maximum (volts/RMS) | Specification MIL-W-22759 | Grade 1 / Grade 2 Manufacturer | Remarks |
|---|---|---|---|---|---|---|---|
| | | Minimum | Maximum | | | | |
| M22759/11-28-X | 7 x 36 | .79 | .90 | 600 | /11 | QPL-22759/11 | Silver-coated, copper conductor<br>Insulated with extruded TFE<br>Suitable for UHF<br>Maximum Temperature 200°C |
| M22759/11-26-X | 19 x 38 | .91 | 1.02 | | | | |
| M22759/11-24-X | 19 x 36 | 1.04 | 1.14 | | | | |
| M22759/11-22-X | 19 x 34 | 1.19 | 1.30 | | | | |
| M22759/11-20-X | 19 x 32 | 1.42 | 1.52 | | | | |
| M22759/11-18-X | 19 x 30 | 1.68 | 1.78 | | | | |
| M22759/11-16-X | 19 x 29 | 1.85 | 1.96 | | | | |
| M22759/11-14-X | 19 x 27 | 2.24 | 2.34 | | | | |
| M22759/11-12-X | 19 x 25 | 2.74 | 2.90 | | | | |
| M22759/11-10-X | 37 x 26 | 3.43 | 3.63 | | | | |
| M22759/11- 8-X | 33 x 29 | 5.03 | 5.23 | | | | |
| M22759/9-22-X | 19 x 34 | 1.47 | 1.57 | 1000 | /9 | QPL-22759/9 | |
| M22759/9-20-X | 19 x 32 | 1.68 | 1.78 | | | | |
| M22759/9-18-X | 19 x 30 | 1.93 | 2.03 | | | | |
| M22759/9-16-X | 19 x 29 | 2.11 | 2.21 | | | | |

NOTES:
1. For the "X" suffix, substitute the appropriate color code designator from MIL-STD-681 (listed on page 16-5).

# WIRE
## Electrical, Insulated, Lightweight

| MIL Style[1] | Strands No. x AWG # | Diameter over Insulation, mm | | Voltage Rating, Maximum (volts/RMS) | Specification MIL-W-22759 | Grade 1 / Grade 2 Manufacturer | Remarks |
|---|---|---|---|---|---|---|---|
| | | Minimum | Maximum | | | | |
| M22759/18-26-X | 19 x 38 | .762 | .864 | 600 | /18 | QPL-22759/18 | Tin-coated copper conductor<br>Insulated with extruded ETFE<br>Maximum temperature 150°C; suitable for use as hookup wire. |
| M22759/18-24-X | 19 x 36 | .864 | .965 | | | | |
| M22759/18-22-X | 19 x 34 | 1.04 | 1.14 | | | | |
| M22759/18-20-X | 19 x 32 | 1.24 | 1.35 | | | | |
| M22759/18-18-X | 19 x 30 | 1.50 | 1.60 | | | | |
| M22759/18-16-X | 19 x 29 | 1.65 | 1.75 | | | | |
| M22759/18-14-X | 19 x 27 | 2.01 | 2.11 | | | | |
| M22759/18-12-X | 37 x 28 | 2.57 | 2.67 | | | | |
| M22759/18-10-X | 37 x 26 | 3.15 | 3.25 | | | | |

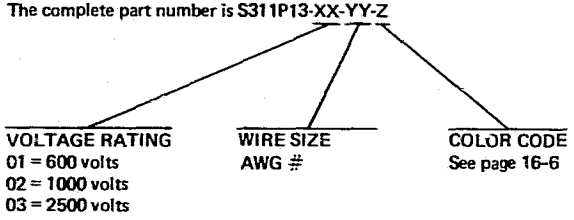
NOTES:
1. For the "X" suffix, substitute the appropriate color code designator from MIL-STD-681 (listed on Page 16-5).

# WIRE
## Electrical, Insulated

| Style[1] | 600 Volt | | 1000 Volt | | 2500 Volt | | Specification | Grade 1 / Grade 2 Manufacturer | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| | Strands No. x AWG # | Diameter over Insulation, mm. Max. | Strands No. x AWG # | Diameter over Insulation, mm. Max. | Strands No. x AWG # | Diameter over Insulation, mm. Max. | | | |
| **S311P13-XX-30-Z** | 7 x 38 | .71 | — | — | — | — | GSFC S-311-P-13 | Raychem Corp. | Tin-coated, copper conductor.<br><br>Insulated with crosslinked polyalkene.<br><br>Max. Temp. 135°C<br><br>Suitable for use in wire harnesses. |
| **S311P13-XX-28-Z** | 7 x 36 | .79 | 7 x 36 | .86 | — | — | | | |
| **S311P13-XX-26-Z** | 7 x 34 | .89 | 7 x 34 | 1.04 | — | — | | | |
| **S311P13-XX-24-Z** | 19 x 36 | 1.04 | 19 x 36 | 1.17 | 19 x 36 | 1.50 | | | |
| **S311P13-XX-22-Z** | 19 x 34 | 1.22 | 19 x 34 | 1.35 | 19 x 34 | 1.80 | | | |
| **S311P13-XX-20-Z** | 19 x 32 | 1.42 | 19 x 32 | 1.55 | 19 x 32 | 2.03 | | | |
| **S311P13-XX-18-Z** | 19 x 30 | 1.68 | 19 x 30 | 1.88 | 19 x 30 | 2.29 | | | |
| **S311P13-XX-16-Z** | 19 x 29 | 1.88 | 19 x 29 | 2.08 | 19 x 29 | 2.54 | | | |
| **S311P13-XX-14-Z** | 19 x 27 | 2.29 | 19 x 27 | 2.49 | 19 x 27 | 3.00 | | | |
| **S311P13-XX-12-Z** | 37 x 28 | 2.84 | 19 x 25 | 3.23 | 19 x 25 | 3.71 | | | |
| **S311P13-XX-10-Z** | — | — | 37 x 26 | 3.61 | 37 x 26 | 4.19 | | | |
| **S311P13-XX-8-Z** | — | — | 133 x 29 | 5.28 | 133 x 29 | 5.79 | | | |
| **S311P13-XX-6-Z** | — | — | — | — | 133 x 27 | 7.06 | | | |
| **S311P13-XX-4-Z** | — | — | — | — | 133 x 25 | 8.53 | | | |
| **S311P13-XX-2-Z** | — | — | — | — | 665 x 30 | 10.1 | | | |
| **S311P13-XX-0-Z** | — | — | — | — | 1045 x 30 | 12.4 | | | |
| **S311P13-XX-00-Z** | — | — | — | — | 1330 x 30 | 14.2 | | | |

NOTES:

1. The complete part number is S311P13-XX-YY-Z



## Color Code Designators
## for Wire According to MIL-STD-681

| Base Color | 1st Stripe | 2nd Stripe | Designator | Base Color | 1st Stripe | 2nd Stripe | Designator | Base Color | 1st Stripe | 2nd Stripe | Designator |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Black | | | 0 | White | Black | Brown | 901 | White | Orange | Yellow | 934 |
| Brown | | | 1 | White | Black | Red | 902 | White | Orange | Green | 935 |
| Red | | | 2 | White | Black | Orange | 903 | White | Orange | Blue | 936 |
| Orange | | | 3 | White | Black | Yellow | 904 | White | Orange | Violet | 937 |
| Yellow | | | 4 | White | Black | Green | 905 | White | Orange | Gray | 938 |
| Green | | | 5 | White | Black | Blue | 906 | | | | |
| Blue | | | 6 | White | Black | Violet | 907 | White | Yellow | Green | 945 |
| Violet | | | 7 | White | Black | Gray | 908 | White | Yellow | Blue | 946 |
| Gray | | | 8 | | | | | White | Yellow | Violet | 947 |
| White | | | 9 | White | Brown | Red | 912 | White | Yellow | Gray | 948 |
| | | | | White | Brown | Orange | 913 | | | | |
| White | Black | | 90 | White | Brown | Yellow | 914 | White | Green | Blue | 956 |
| White | Brown | | 91 | White | Brown | Green | 915 | White | Green | Violet | 957 |
| White | Red | | 92 | White | Brown | Blue | 916 | White | Green | Gray | 958 |
| White | Orange | | 93 | White | Brown | Violet | 917 | | | | |
| White | Yellow | | 94 | White | Brown | Gray | 918 | White | Blue | Violet | 967 |
| White | Green | | 95 | | | | | White | Blue | Gray | 968 |
| White | Blue | | 96 | White | Red | Orange | 923 | | | | |
| White | Violet | | 97 | White | Red | Yellow | 924 | White | Violet | Gray | 978 |
| White | Gray | | 98 | White | Red | Green | 925 | | | | |
| | | | | White | Red | Blue | 926 | | | | |
| | | | | White | Red | Violet | 927 | | | | |
| | | | | White | Red | Gray | 928 | | | | |

# APPENDIX A
## Upgrading Grade 2 Devices for Use in Grade 1 Applications

Both PPL-15 and MIL-STD-975C have sections in which the listed Grade 1 part is not available at this time or, in the case of the NSPL, no Grade 1 part is listed. This appendix lists what is required by GSFC to upgrade a Grade 2 device for use in a Grade 1 application. In most cases, GSFC requirements are the same as those in the NSPL. GSFC does not allow the upgrading of relays. The PPL has differences from the NSPL in the procedures to upgrade semiconductor devices. In all cases, the upgrading of a Grade 2 part for a Grade 1 application requires the approval of the project parts engineer.

Section 1 -- CAPACITORS

For styles listed in MIL-STD-975C, see Appendix B of that document. For styles listed in PPL-15, where the appropriate Failure Rate Level is not available, the approval of the project parts engineer is required to use the next lowest available level.

Section 3 – FILTERS

Consult the project parts engineer.

Section 4 – FUSES

GSFC considers the fuses in Section 4 of PPL-15 to be suitable for Grade 1 use as listed in the PPL.

Section 5 – INDUCTORS

For styles listed in MIL-STD-975, see Appendix B of that document.

Section 6 – RELAYS

GSFC does not consider any of the MIL-R-39016 relays in MIL-STD-975 suitable for upgrading to Grade 1. If it is not possible to use one of the S-311-P-2(06) relays listed in PPL-15, then consult the projects parts engineer for advice in selection of a suitable relay.

Section 7 – RESISTORS

When the appropriate Failure Rate Level is not available, the approval of the project parts engineer is required to use the next lowest available level.

Section 8 – DIODES

Grade 2 diodes listed in PPL-15 and MIL-STD-975C may be upgraded for use in Grade 1 applications by two methods:

(a) In accordance with Appendix B of MIL-STD-975C.

(b) When a procurement consists of not more than 100 devices, perform destructive physical analysis on 5 diodes from the lot and rescreen the JTXV diodes to the JANS screening requirements (except for internal visual inspection).

Section 9 – TRANSISTORS

Grade 2 transistors listed in PPL-15 and MIL-STD-975C may be upgraded for use in Grade 1 applications by two methods:

(a) In accordance with Appendix B of MIL-STD-975C.

(b) When a procurement consists of not more than 100 devices, perform destructive physical analysis on 5 transistors from the lot and rescreen the JTXV transistors to the JANS screening requirements (except for internal visual inspection).

## Section 10 – MICROCIRCUITS

Grade 2 microcircuits listed in MIL-STD-975C may be upgraded for use in Grade 1 applications by two methods:

(a) In accordance with Appendix B of MIL-STD-975C except that the "Internal Visual for DPA" test listed in Table 3.2 shall include a Scanning Electron Microscope (SEM) inspection according to MIL-STD-883, Method 2018 (test 2 parts – accept on zero (0) rejects).

(b) When a procurement consists of not more than 100 devices, the screening given in Appendix B of MIL-STD-975C will be used and the following procedure will be substituted for the Group B tests listed in Table 3.2 of Appendix B of MIL-STD-975C. Choose 5 devices at random from the lot and subject them to the following tests:

| Test | MIL-STD-883 Method | Qty. to Test/ Accept No. | Remarks |
|---|---|---|---|
| Lid Torque | 2024 | 2/0 | Glass Frit Seal packages only |
| Internal Visual | 2013 | 5/0 | |
| SEM Inspection | 2018 | 2/0 | |
| Bond Strength | 2011 | 2/0 | All bonds shall be pulled and meet the specified limit |
| Die Shear | 2019 | 3/0 | |

## Section 14 – THERMISTORS

For styles listed in MIL-STD-975C, consult your project parts engineer.

## Section 15 – TRANSFORMERS

For styles listed in MIL-STD-975C, see Appendix B of that document.

## Section 16 – WIRE and CABLE

For styles listed in MIL-STD-975C, consult your project parts engineer.

## MISCELLANEOUS

For device types listed in MIL-STD-975C but not in PPL-15, consult your project parts engineer.

# APPENDIX B
## Parts Derating Factors

This appendix tabulates GSFC's recommendations for the derating of the component types listed in the NSPL and PPL-15. Many of these derating recommendations are identical to those given in MIL-STD-975C. Where differences occur, they are based on GSFC experiences and failure rates in MIL-HDBK-217C. These factors are guidelines and may have to be modified to suit the needs of a particular project. Such modifications are to be made only with the review and approval of the project.

## Table 01.
## Derating Outline for Capacitors

| Dielectric Class | Derate to Following Percentage (%) | | | Maximum Ambient Operating Temperature °C |
|---|---|---|---|---|
| | Rated Voltage | Ripple Voltage | In-Rush Current | |
| Ceramic (CKR), (CDR) | 60 | N/A | 70 | 85 |
| Plastic Film (CRH)[1] | 60 | | | |
| Glass or Porcelain (CYR) | 50 | | | |
| Tantalum (Solid Electrolyte) (CSR) | | 75 | | |
| >1 ohm/volt effective circuit impedance | 50 | | | 50 |
| <1 ohm/volt effective circuit impedance <20 Volts | 40 | | | |
| <1 ohm/volt effective circuit impedance >20 Volts | 30 | | | |
| Tantalum (Wet Electrolyte) (CLR) | 60 | | | 70 |
| Tantalum Foil (CLR) | 50 | | | |

NOTES:
1. CRH styles are not approved for use in circuits where the energy is less than 500 μjoules.

## Table 02. Derating Outline for Connectors

| Number of Contacts Used in Connector | Contact Size | Maximum Current Per Contact[1] (Amperes) | | | | | | | Maximum Operating Voltage |
|---|---|---|---|---|---|---|---|---|---|
| | | Wire Size (AWG) | | | | | | | |
| | | 16 | 18 | 20 | 22 | 24 | 26 | 28 | |
| 1 to 4 | 16 | 13.0 | 9.2 | 6.5 | | | | | 25% of rated Dielectric Withstanding Voltage |
| 1 to 4 | 20 | | | 6.0 | 4.5 | 3.3 | | | |
| 1 to 4 | 22 | | | | 4.5 | 3.3 | 2.5 | 1.8 | |
| 5 to 14 | 16 | 9.0 | 7.0 | 5.0 | | | | | |
| 5 to 14 | 20 | | | 5.0 | 3.5 | 2.7 | | | |
| 5 to 14 | 22 | | | | 3.5 | 2.7 | 1.9 | 1.4 | |
| 15 or more | 16 | 6.5 | 5.0 | 3.7 | | | | | |
| 15 or more | 20 | | | 3.7 | 2.5 | 2.0 | | | |
| 15 or more | 22 | | | | 2.5 | 2.0 | 1.4 | 1.0 | |

NOTE:
1. Maximum current may be carried by only 10% of the contacts at one time. At such time, other contacts should be limited to 100 mA.

## Table 03. Derating Outline for EMI Filters

| Class | Derate To | Maximum Ambient Temperature |
|---|---|---|
| All Filters | 50% rated feed through current and 50% rated DC working voltage | 85°C |

NOTE: Consult the GSFC Parts Branch (Code 311) for assistance in derating other filter types.

## Table 04. Derating Outline for Fuses

| Fuse Current Rating (Amperes) | Derate to the Following (%) of Rated Current | Remarks |
|---|---|---|
| 15 | 50% | 1, 2, 3 |
| 10 | 50% | |
| 5 | 50% | |
| 2 | 50% | |
| 1 | 45% | |
| 1/2 | 40% | |
| 3/8 | 35% | |
| 1/4 | 30% | |
| 1/8 | 25% | |

NOTE:

1. Derating factors are based on data from fuses mounted on printed circuit boards and conformally coated. For other type mountings, consult the GSFC project parts engineer for recommendations.
2. Derating of fuses also allows for possible loss of pressure, which lowers the blow current rating and allows for a decrease of current capability with time.
3. Fuse current ratings are based on a measured blow current of 200% rated current for a maximum of 5 seconds to blow the fuse and a minimum ratio of 4/1 of blow to operating current. The mimimum of 4/1 of blow to operating currents corresponds to the 50% derating factor. An 8/1 ratio of blow to operating currents corresponds to the 25% derating factor for the 1/8 ampere fuse. For maximum life in critical space applications, GSFC recommends an 8/1 ratio.

## Table 05.
## Derating Outline for Inductors/Coils

| Class Per MIL-C-39010 | Class Per MIL-C-15305 | Maximum Operating Temperature | Derate To |
|---|---|---|---|
| - | O | 65°C | 50% of Maximum rated voltage. |
| A | A | 85°C | |
| B | B | 105°C | |

NOTES:

1. a) Maximum operating temperature equals ambient temperature + temperature rise + 10°C (allowance for hot spot). Compute temperature rise as follows:

$$\text{Temperature rise } (^{\circ}C) = \frac{R - r}{r} (T + 234.5)$$

Where R = Winding resistance under load
r = No load winding resistance at ambient temperature T(°C).

b) The insulation classes of MIL style inductive parts have maximum operating temperature ratings which are generally based upon a life expectancy of at least 10,000 hrs. The maximum operating temperatures in this table are selected to extend the life expectancy to 50,000 hrs.

c) Custom made inductive devices shall be evaluated on a materials basis and stressed at levels below the maximum rated operating temperature for the materials used. Devices having a maximum rated operating temperature in the range of 85°C to 130°C, shall be derated to: Maximum Operating Temperature (°C) = .75 x Maximum Rated Operating Temperature (°C). For devices with maximum rated temperatures outside this temperature interval consult the project parts engineer for temperature derating recommendations.

## Table 06.
## Derating Outline for Relays

| Class | Derate To | Remarks |
|---|---|---|
| All Relays | 50% of rated contact current | Users are cautioned not to derate coil current or voltage, as this can result in non-operation of the device. |

## Table 07.
## Derating Outline for Resistors

| Type | Derate To | Remarks |
|---|---|---|
| Carbon composition, Style RCR | 60% of Rated Power | All resistors: (a) Maximum voltage shall not exceed 80% of the maximum rated voltage on any resistor. (b) Resistors with weldable nickel leads shall be derated by an additional factor of 0.5 |
| Film, General Purpose, Style RLR | 60% of Rated Power | |
| Wirewound, Accurate, Style RBR | | |
| 1% Tolerance | 60% of Rated Power | |
| 0.5% Tolerance | 35% of Rated Power | |
| 0.1% Tolerance | 25% of Rated Power | |
| Wirewound, Power, Chassis Mount, Style RER | 60% of Rated Power | |
| Wirewound, Power, Style RWR | 60% of Rated Power | |
| Variable Trimmers, Styles RTR & RJR | 70% of Rated Current | |
| Thick Film, Style SHV | 60% of Rated Power | |
| Film, High Stability, Style RNC | 60% of Rated Power | |

## Table 08.
## Derating Outline for Diodes

| Class | Derate to the Following Percentage | |
|---|---|---|
| | Peak Inverse Voltage | Junction Temperature |
| Diodes, Rectifiers | 75 | 60[1,2] |
| Diodes, Small Signal Switching | | |
| Diodes, Voltage Reference, Voltage Regulator, Current Regulator, Variable Capacitor | | |
| Diodes, Silicon Controlled Rectifier, Voltage Suppressor, PIN, Schottky Barrier Switching, Light Emitting | Consult project parts engineer for identification of parameters to be derated and recommended derating factors. Derating will be determined on an individual part type basis. | |

**NOTE 1:** All Devices

Derate junction temperature as follows:

$T_J(\text{derated}) = \text{Derating Factor} \times [T_J(\text{max}) - 25°C] + 25°C$. = Maximum allowable operating junction temperature.

$T_J(\text{max})$ = Manufacturer's specified maximum junction temperature.

**NOTE 2:** Derate average forward current ($I_O$) to satisfy junction temperature derating calculated in note 1, as follows:

Devices Operated Without Heat Sink (Figure 1)

$I_{O(\text{allowed})} = \text{Derating Factor} \times I_{O(\text{max})}, T_A \leq 25°C$

$I_{O(\text{allowed})} = \text{Derating Factor} \times I_{O(\text{max})} \left[1 - \frac{T_A - 25°C}{T_{J(\text{derated})} - 25°C}\right], T_A > 25°C$

$I_{O(\text{max})}$ = Manufacturer's absolute maximum current rating.

$T_A$ = Ambient temperature.

Devices Operated With Heat Sink (Figure 2)

$I_{O(\text{allowed})} = \text{Derating Factor} \times I_{O(\text{max})}, T_{Case} \leq T_D$

$I_{O(\text{allowed})} = \text{Derating Factor} \times I_{O(\text{max})} \left[1 - \frac{T_{case} - T_D}{T_{J(\text{derated})} - T_D}\right], T_{Case} > T_D$

$T_D = T_{J(\text{derated})} - \text{Derating Factor} (T_{J(\text{max})} - T_M)$

$T_D$ = Case temperature above which $I_O$ must be further derated to satisfy derated junction temperature.

$T_M$ = Maximum case temperature at which manufacturer permits full rated current. ($I_{O\text{max}}$);

$I_{O(\text{max})}$ = Manufacturer's absolute maximum average forward current.

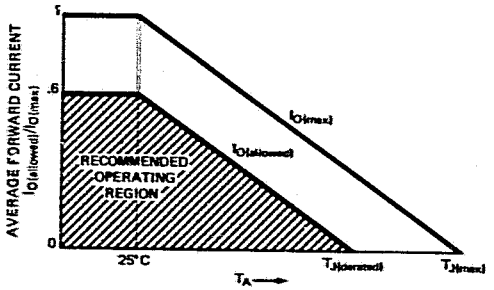



Figure 1. Derating curve from MIL-HDBK-217 modified to show operating region for devices operated without heat sinks and a Derating Factor of 0.6.

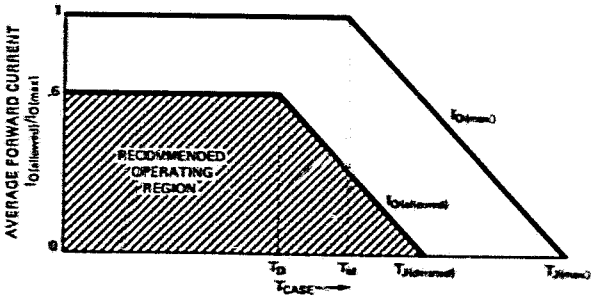



Figure 2. Derating curve from MIL-HDBK-217 modified to show operating region for devices operated with heat sinks and a Derating Factor of 0.6.

## Table 09.
## Derating Outline for Transistors

| Class | Derate to the Following Percentage | | | |
|---|---|---|---|---|
| | Voltage | Current | Power | Junction Temperature |
| Silicon NPN, PNP<br>Low power, Med. power, High power, Switching, Dual, Complimentary, Chopper, Unijunction.<br><br>J-FET, N-Channel, P-Channel<br>General Purpose, Med. Power, High Power, High Speed Switching | 75 | 75 | 60 | 60 |
| RF NPN,<br>Microwave Power, Phototransistor, Opto-coupler. | Consult project parts engineer for identification of parameters to be derated and recommended derating factors. Derating will be determined on an individual part type basis. | | | |

**NOTE 1:** All devices:
Derate junction temperature as follows:
$T_J$(derated) = Derating Factor X [$T_J$(max)-25°C]+25°C = Maximum recommended operating junction temperature.
$T_J$max = Manufacturer's specified maximum junction temperature.

**NOTE 2:** Derate power dissipation to satisfy the junction temperature derating calculated in Note 1, as follows:

Devices operated without heat sink (Figure 1)

$P_D$(allowed) = Derating Factor X $P_D$(max), $T_A \leq 25°C$

$$P_D(\text{allowed}) = \frac{T_J(\text{derated}) - T_A}{R_{\theta J\text{-}A}},\ T_A > 25°C$$

$P_D$max = Mfr's absolute maximum power rating.
$R_{\theta J\text{-}A}$ = Junction to ambient thermal resistance from mfr's data sheet (°C/watt).
$T_A$ = Ambient temperature.

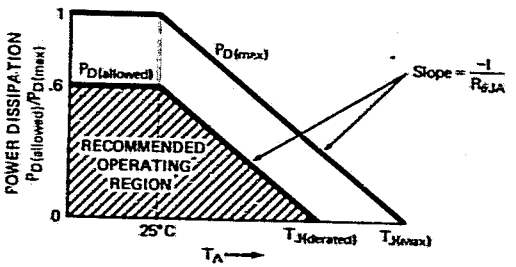



Figure 1. Derating curve from MIL-HDBK-217 modified to show operating region for devices operated without heat sinks and a Derating Factor of 0.6.

Devices operated with heat sink (Figure 2)

$P_D$(allowed) = Derating Factor X $P_D$(max), $T_{case} \leq T_D$

$$P_D(\text{allowed}) = \frac{T_J(\text{derated}) - T_{case}}{R_{\theta JC}},\ T_{case} > T_D$$

$T_D = T_J$(derated) – $R_{\theta J\text{-}C}$[Derating Factor X $P_D$max].
$T_D$ = Case temperature above which power must be further reduced to satisfy junction temperature requirements.
$P_D$max = Mfr's specified absolute maximum power rating.
$R_{\theta JC}$ = Junction to case thermal resistance specified in mfr's data sheet (°C/watt).

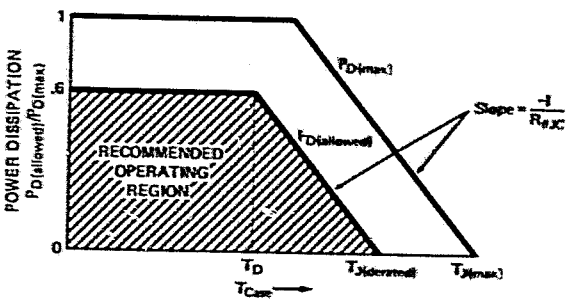



Figure 2. Derating curve from MIL-HDBK-217 modified to show operating region for devices operated with heat sinks and a Derating Factor of 0.6.

## Table 10
## Derating Outline for Microcircuits[1]

| Type | | Derate to the Following Percentage | | | |
|---|---|---|---|---|---|
| | | Supply Voltage | Power | Input Voltage | Output Current |
| Digital | TTL | 100 | 80 | 100 | 80 |
| | CMOS | 70 | | 70 | |
| | NMOS | 100 | | 100 | |
| Operational Amplifier | | 80 | 75 | 70 | 80 |
| Voltage Regulator | | N.A. | 80 | 80 | 80[2] |
| Voltage Comparator | | 90 | 75 | 80 | 80 |
| Sense Amplifier | | 80 | | 70 | |
| Current Amplifier | | 80 | | 80 | |
| Analog Switch | | 90 | 80 | 90 | |
| Line Drivers and Receivers | | 100 | | 100 | |

NOTES:

1. Maximum ambient temperature is 85°C.
2. Derate to 50% of rated current for two-terminal regulators.

## Table 14.
## Derating Outline for Thermistors
## (Temperature Sensitive Resistor)

| Class | Derate To |
|---|---|
| All Thermistors | 50% of rated power |

## Table 15.
## Derating Outline for Transformers

| Class Per MIL-T-27 | Class Per MIL-T-21038 | Maximum Operating Temperature[1] | Derate To |
|---|---|---|---|
| Q | Q | 65°C | 50% of Maximum rated voltage. |
| R | R | 85°C | |
| S | S | 105°C | |

NOTE:

1. a) Maximum operating temperature equals ambient temperature + temperature rise + 10°C (allowance for hot spot). Compute temperature rise as follows:

$$\text{Temperature rise } (^\circ C) = \frac{R - r}{r} (T + 234.5) - (T - t)$$

Where R = Winding resistance under load.
r = No load winding resistance at ambient temperature T(°C).
t = Initial ambient temperature (°C).
T = Ambient temperature at power shutoff. T shall not differ from t by more than 5°C.

b) The insulation classes of MIL style inductive parts have maximum operating temperature ratings which are generally based upon a life expectancy of at least 10,000 hrs. The maximum operating temperatures in this table are selected to extend the life expectancy to 50,000 hrs.

c) Custom made inductive devices shall be evaluated on a materials basis and stressed at levels below the maximum rated operating temperature for the materials used. Devices having a maximum rated operating temperature in the range of 85°C to 130°C, shall be derated to: Maximum Operating Temperature (°C) = .75 x Maximum Rated Operating Temperature (°C). For devices with maximum rated temperatures outside this temperature interval consult the project parts engineer for temperature derating recommendations.

## Table 16.
## Derating Outline for Wire and Cable

| Wire Size | Derate To – Amperes Maximum | | Remarks |
|---|---|---|---|
| | Bundle or Cable | Single | |
| 30 | 0.7 | 1.3 | 1. Current ratings for bundles or cables are based on bundles of 15 or more wires at 70°C in a hard vacuum. For smaller bundles the allowable current may be proportionally increased as the bundle approaches a single wire.<br><br>2. Ratings are based on Teflon insulated wire (Type TFE). |
| 28 | 1.0 | 1.8 | |
| 26 | 1.4 | 2.5 | |
| 24 | 2.0 | 3.3 | |
| 22 | 2.5 | 4.5 | |
| 20 | 3.7 | 6.5 | |
| 18 | 5.0 | 9.2 | |
| 16 | 6.5 | 13.0 | |
| 14 | 8.5 | 19.0 | |
| 12 | 11.5 | 25.0 | |
| 10 | 16.5 | 33.0 | |
| 8 | 23.0 | 44.0 | |
| 6 | 30.0 | 60.0 | |
| 4 | 40.0 | 81.0 | |
| 2 | 50.0 | 108.0 | |
| 0 | 75.0 | 147.0 | |
| 00 | 87.5 | 169.0 | |

# APPENDIX C
## Screening of Electronic Parts for Flight Equipment

This appendix to the PPL lists the minimum screening requirements which must be incorporated into procurement documents when nonstandard parts are to be procured. It specifies nominal levels of screening to be imposed on conventional MIL and commercial parts for flight applications when Established Reliability (ER), TXV, or parts to other high reliability MIL or NASA specifications are not available. (Refer to the Preface for a brief explanation of ER and TXV parts.) These screens are the minimum requirements to reduce the risk of fabricating into a system parts which do not meet advertised characteristics or which may fail latently in the system.

Because of the inherently higher risk with nonstandard parts, additional parts over the quantity needed for fabrication should be procured for test and analysis. Destructive physical analysis is recommended to ascertain the quality of construction and the workmanship applied in fabricating the parts. Step-stress testing, similar to that specified in MIL-STD-883, Method 5006, "Limit Testing", is recommended. It can yield information on failure modes to which the parts may be susceptible. These tests and analyses can determine if serious reliability hazards exist with parts for a particular application, and permit a better assessment of the risk incurred with their use.

A procurement document which is made up only of the parameters from the manufacturer's data sheet and the screens listed in the appropriate table of this appendix, is not comparable with military specifications or source controlled drawings which control other aspects of parts manufacture. The latter documents contain requirements for process controls, device construction, lot acceptance, and qualification in addition to screening. Ideally such documents should be developed for each nonstandard part, but the quantity of devices involved in a procurement, schedules, or economic constraints often preclude the development and use of such complete specifications.

For help in developing complete procurement requirements when a nonstandard part must be used, users are urged to consult their project parts engineers or the cognizant section of the Parts Branch.

## Table 01.
## Screening Outline for Capacitors[1]

| Test Sequence / Category | 1<br>Initial Examination per Reference Documents[2] | 2<br>Thermal Shock MIL-STD-202, Method 107 | 3<br>Seal Leak Tests MIL-STD-202, Method 112 | 4<br>Radiographic MIL-STD-202, Method 209 | 5<br>Conditioning per Referenced Documents | 6<br>Final Examination per Reference Documents | Reference Documents MIL-STD-202 |
|---|---|---|---|---|---|---|---|
| (a) Air or Glass, Variable | Visual & Mechanical, C, Q, DWV IR, Driving Torque | Test Condition A | N/A | N/A | N/A | Repeat Initial Examination | MIL-C-14409 |
| (b) Ceramic | Visual & Mechanical, C, DF, DWV, IR | Test Condition A, except step 3 shall be at max. rated temperature | N/A | In accordance with MIL-C-39014. N/A to style CD | 2 x rated voltage @ max. rated temperature for 96 hours | | MIL-C-20<br>MIL-C-39014<br>MIL-C-55681 |
| (c) Glass & Porcelain | | Test Condition B | | N/A | 2 x rated voltage @ 398 K for 96 hours | | MIL-C-23269 |
| (d) Mica | | Test Condition A, except step 3 shall be at max. rated temperature | | | 2 x rated voltage @ max. rated temperature for 96 hours | | MIL-C-39001 |
| (e) Paper & Polyethylene terephalate | | Test Condition B | Test Condition E | In accordance with MIL-C-19978 | 1.4 x rated voltage @ 125°C for 96 hours | | MIL-C-19978 |
| (f) Polycarbonate, metallized film | | Test Condition A, except step 3 shall be at 398 K | Test Conditions C, E | N/A | 1.4 x rated voltage @ 100°C for 96 hours | | MIL-C-83421 |
| (g) Tantalum Electrolytic, Wet Slug | Visual & Mechanical, C, DF, DC Leakage | Test Condition A | Acid Indicator test per GSFC SP 01.23 | | Rated voltage @ 85°C for 168 hours | | MIL-C-39006<br>GSFC<br>SP 01.23 |
| Foil | | | Test Conditions A and C Hermetic seal styles only | | Rated voltage at 85°C | | |
| (h) Tantalum Electrolytic, Solid<br>(1)Hermetically sealed | | | Test Condition C | In accordance with MIL-C-39003 | Rated voltage at 85°C Surge Current Test Per MIL-C-39003/6[4] | | MIL-C-39003 |
| (2)Non-hermetically sealed | | | N/A | N/A | | | GSFC S-311-P-17(01) |
| (i) High Voltage Ceramic | Visual & Mechanical C, DF, IR, DWV, dc Corona | Test Condition A | N/A | | Rated Voltage rated Temperature 100 hours | | GSFC S-311-P-15(01) |

NOTES: 1. Test procedures and requirements are in accordance with those in the applicable Military or NASA referenced document. For additional information see the referenced document or consult the EEE Parts Section, Parts Branch. For complete procurement requirements, consult your Project Parts Engineer.
2. Legend: C = Capacitance, DF = Dissipation Factor, DWV = Dielectric Withstanding Voltage, IR = Insulation Resistance, Q = Quality Factor.
3. Voltage conditioning shall be conducted for 168 hours for polarized styles. For non-polarized styles, voltage conditioning shall be conducted for 192 hours with the voltage polarity reversed after 98 hours.
4. Surge current screening is required for devices intended for circuit applications having less than 3 ohm/volt effective circuit impedance. For non-polarized styles, the surge current test (when required) shall be in both directions (polarities).

## Table 03.
## Screening Outline for EMI Suppression Filters[1,2]

| Test Sequence / Category | 1<br>Initial Measurements and Examinations | 2<br>Temperature Cycling | 3<br>Seal Leak Tests | 4<br>Voltage Conditioning | 5<br>Final Measurements and Examinations | Reference Documents |
|---|---|---|---|---|---|---|
| Filters, EMI Suppression (with Ceramic Capacitor Elements) | 1. Visual<br>2. Dielectric Withstanding Voltage (DWV)<br>3. Capacitance (when applicable)<br>4. Dissipation Factor (DF) (when applicable)<br>5. Insulation Resistance (IR) @ 25°C and rated elevated temperature<br>6. D.C. Resistance<br>7. Radiographic examination | 5 cycles per MIL-STD-202 Method 107 Test Condition A.<br><br>However, at no time shall either temperature extreme exceed the temperature rating of the filter. | Fine and Gross Leak tests. (Applicable to hermetically sealed devices, only.) | Rated voltage at rated elevated temperature for 240 hrs., minimum. | Repeat initial examinations and measurements, except radiographic examination. Add insertion loss tests. Select on basis of IR absolute values and stability. | GSFC S-311-P-5(03), Rev. 1<br><br>MIL-STD-202<br><br>MIL-STD-220 |

NOTES:
1. Consult the GSFC Parts Branch (Code 311) for assistance in screening other types of filters.
2. For complete procurement requirements, consult your Project Parts Engineer.

## Table 04.
## Screening Outline for Subminiature Fuses[1]

| Test Sequence / Category | 1 | 2 | 3 | 4 | Reference Documents |
|---|---|---|---|---|---|
| | Initial Measurements | Thermal Shock | Final Measurements | Acceptance Criteria | |
| Fuses, Subminiature<br><br>FM08, FM04 | Perform visual and mechanical inspections per paragraph 3.5 of MIL-F-23419.<br><br>Measure cold resistance at 10% or less of rated current.<br><br>Subject fuses to 100% rated current for not less than 5 minutes. Maintain current at this level and measure the voltage drop within the next 5 minutes Calculate $^{R}HOT_1$ (voltage drop/rated current)$^2$. | MIL-STD-202 method 107, condition B | Repeat Initial inspection and measurements Calculate = $^{R}HOT_2$ | GSFC recommends using fuses in lower half of the FM08 voltage drop range and those where $^{R}HOT_1$ and $^{R}HOT_2$ differ by less than 3% | MIL-F-23419<br>MIL-F-23419/4<br>MIL-F-23419/8 |

NOTES:

1. For complete procurement requirements, consult your Project Parts Engineer.
2. Tests shall be designed to minimize the time, in excess of 5 minutes, that the fuses are subjected to full rated currents. These fuses should not be operated at rated currents for more than 30 minutes or parts may be degraded so that fuse life is reduced. MIL-F-23419 specifies minimum life at 110% of Rated Current to be 1.5 hours according to lot sampling tests. Rated current according to MIL-F-23419 is "the amount of current the fuse will carry indefinitely without interruption."

## Table 05.
## Screening Outline for Inductors/Coils[1]

| Test Sequence / Category | 1 | 2 | 3 | 4 | Reference Document |
|---|---|---|---|---|---|
| | Initial Measurements | Thermal Shock | Burn-In | Final Measurements and Tests | |
| Coils, Fixed, Molded, RF | 1. Visual Inspection<br>2. D.C. Resistance<br>3. Insulation Resistance (IR)<br>4. Dielectric Withstanding Voltage (DWV)<br>5. Inductance (L)<br>6. Q<br>7. Self Resonant Frequency (SRF) | MIL-STD-202 Method 107, Condition A-1, use maximum operating temperature of coil. | 48 hrs. at rated current at rated maximum operating temperature. | Visual Inspection<br>Repeat initial measurements.<br><br>Reject criteria:<br>ΔR>±3%,<br>ΔL>±3%,<br>Q<min. specified,<br>SRF<min. specified,<br>DWV<min. specified,<br>IR<min. specified. | MIL-C-39010 |

NOTE:
1. For complete procurement requirements, consult your Project Parts Engineer.

## Table 06.
## General Screening Outline for Relays[1]

| Test Sequence | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | External Visual Examination | Seal Leak Test | Initial Measurements | Vibration | High Temp Soak | Low Temp Miss Test | Room Temp Miss Test | Seal Leak Test | Final Measurements | External Visual Examination | Reference Document[2] |
| Relays - Latching and Non-Latching | Para. 3.5 | Para. 3.6<br>Fine leak: Para. 3.6.1<br>Gross leak: Para. 3.6.2 | Para. 3.7<br>Coil Resistance<br>Pull In and Drop Out Voltage<br>Contact Resistance<br>Contact Transfer Characteristics<br>Insulation Resistance<br>Dielectric Strength | Para. 3.8<br>100-2000 Hz 30g peak | Para. 3.10<br>16 hrs at 125°C | Para. 3.12<br>1000 operation miss test at -65°C | Para. 3.13<br>5000 operation miss test at 25°C | Para. 3.6.1 and 3.6.2<br>Repeat test sequence no. 2 | Para. 3.7<br>Repeat test sequence no. 3 | Para. 3.5 | GSFC-S-311-P2(06)<br>Contains procedures for these screening subtests. |

NOTES:

1. For additional information, and to establish rejection criteria, see the reference documents or consult the EEE Parts Section, Parts Branch. For complete procurement requirements, consult your Project Parts Engineer.
2. Other screening tests in this specification are provided for special applications.

## Table 07.
## Screening Outline for Resistors[1]

| Category \ Test Sequence | 1 | 2 | 3 | 4 | 5 | Reference Document |
|---|---|---|---|---|---|---|
| | Initial Measurements | Thermal Shock | Conditioning | Seal Leak Test[2] | Final Measurements | |
| Resistors, Fixed, Carbon Comp., RCR Style | Visual Inspection<br>Resistance | — | — | — | — | MIL-R-39008<br>Group A<br>Inspection |
| Resistors, Fixed, Film, General Purpose, RLR Style | Visual Inspection<br>Resistance | — | 1.5 x rated power at room temperature for 24 hours. | — | Visual Inspection<br>Resistance<br>Reject: ΔR>±0.5% | MIL-R-39017<br>Group A<br>Inspection |
| Resistors, Fixed, Film, High Stability, RNC Style | Visual Inspection<br>Resistance | MIL-STD-202<br>Method 107<br>Cond. F | Style 50, 55, 60: 5 x rated power at room temperature for 1 hour.<br>Style 65: 4 x rated power at room temperature for 1 hour.<br>Style 70 and 75: 2.25 x rated power at room temperature for 1 hour.<br>Style 90: 6.25 x rated power for 5 seconds at room temperature. | MIL-STD-883<br>Method 1014<br>Cond. D<br>(For hermetically sealed units) | Visual Inspection<br>Resistance<br>Reject: ΔR>±0.2%<br>Style 90: ΔR>±0.05% | MIL-R-55182<br>Group A<br>Inspection |
| Resistors, Fixed, Wirewound, Accurate, RBR Style | Visual Inspection<br>Resistance | — | 1.0 x rated power for 1.5 hours on, 0.5 hour off for 100 hours at 25°C. | — | Visual Inspection<br>Resistance<br>Reject: ΔR>±0.01% | MIL-R-39005<br>Group A<br>Inspection<br>Subgroup 1 |
| Resistors, Fixed, Wirewound, Power, RWR Style | Visual Inspection<br>Resistance | — | 1.0 x rated power for 1.5 hours on, 0.5 hour off for 100 hours at 25°C. | — | Visual Inspection<br>Resistance<br>Reject: ΔR>±0.2% | MIL-R-39007<br>Group A<br>Inspection |
| Resistors, Fixed, Wirewound, Power, Chassis Mount, RER Style | Visual Inspection<br>Resistance | — | 1.0 x rated "free air" power for 1.5 hours on, 0.5 hour off for 96 hours at 25°C. | — | Visual Inspection<br>Resistance<br>Reject: ΔR>±0.2% | MIL-R-39009<br>Group A<br>Inspection |
| Resistors, Variable, Wirewound, Low Power, RTR Style | Visual Inspection<br>Resistance | — | 1 watt power for 1.5 hours on, 0.5 hour off for 50 hours at 25°C. | — | Visual Inspection,<br>Resistance, Peak Noise,<br>Continuity, End Resistance,<br>Torque<br>Reject: ΔR>±0.5% | MIL-R-39015<br>Group A<br>Inspection. |
| Resistors, Variable, Non-Wirewound, Low Power, RJR Style | Visual Inspection<br>Resistance | — | 1.5 x rated power for 1.5 hours on, 0.5 hour off for 50 hours at 25°C. | — | Visual Inspection, Resistance, Contact Resistance, End Resistance, Torque<br>Reject: ΔR>±2% (char. C)<br>ΔR>±1.5% (char. F)<br>ΔR>±1% (char. H) | MIL-R-39035<br>Group A<br>Inspection |

NOTES:
1. For complete procurement requirements, consult your Project Parts Engineer.
2. For resistors with nontransparent envelopes, perform the dye penetrant leak test of MIL-STD-883, Method 1014, Cond. D, except substitute the following post exposure inspection procedure:
   (a) thoroughly cleanse the resistors to remove external dye;
   (b) at a minimum temperature of 80°C rotate the resistors about their longitudinal axes (maintain the longitudinal axes horizontal) for a minimum of 2 minutes;
   (c) inspect for evidence of dye leakage.

# Table 08. (page 1 of 4)
## Screening Outline for Diodes[1]

| Part Category \ Test Sequence | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Internal Visual (Precap) Inspection | Initial Insp. & Electrical Parameter Measurements | High Temperature Storage | Thermal Shock (Temperature Cycling) | Acceleration | PIND[2] | FIST[3] | BIST[4] | Seal Leak Tests | Pre-Power and Reverse Bias Burn-In Electrical Measurements | Reverse Bias Burn-In |
| a. Diodes, Small Signal, Silicon | MIL-STD-750 Method 2074. (Since this test can only be performed by the manufacturer, specify internal visual inspection in procurement document.) | Visual Insp. per MIL-STD-750 Method 2071. Measure all electrical parameters. | All devices shall be stored for 48 hrs at $T_A$ = 200°C. If leads are tinned or made of silver, the heating must be in an inert atmosphere or reduce temperature to $T_A$ = 125°C. | MIL-STD-750 Method 1051. (Refers to MIL-STD-202 Method 107 for procedural details.) Test Condition C, except 10 cycles total with 15 minutes rest at each temperature extreme. | MIL-STD-750 Method 2006, except test shall be 20,000 G in $Y_1$ orientation only, one time only. | MIL-STD-750 Method 2052 Only for Grade 1 screening. | MIL-STD-750 Method 2081 Only for Grade 1 screening. | MIL-STD-750 Method 2082 Only for Grade 1 screening. | MIL-STD-750 Method 1071.1. Fine Leak: Test Condition G or H. Gross Leak: Test Condition C. Only for Grade 2 screening. | Serialize devices. Measure $V_F$ and $I_R$. Record values and reject all devices that exceed their specified limits. | None |
| b. Diodes, Switching, Silicon | | | Same as above except $T_A$ = 175°C. | Same as above except maximum temperature is 175°C. | | | | | | | MIL-STD-750 Method 1038 Test Cond. A, 72 hrs at $T_A$ = 150°C. Note: at end of test $V_R$ remains applied until $T_A$ = 30°C. |
| c. Diodes, Voltage Reference, Silicon | | | | | | | | | | Same as above except measure BV and Z. | Same as above except 96 hrs at $T_A$ = 150°C with $I_Z$ = rated value. |
| d. Diodes, Voltage Regulator, Silicon | | | | | | | | | | Same as above except measure BV, $I_R$ and Z. | Same as above except 96 hrs at $T_A$ = 25°C with $I_Z$ = maximum rated value. |
| e. Diodes, Power Rectifier, Silicon, (Fast Recovery or Gen. Purpose) | | | | | | | | | | Same as Part Category a. except measure $V_f$ and $I_R$. | None |

Notes:

1. For complete procurement requirements, consult your project parts engineer.
2. PIND = Particle Impact Noise Detection
3. FIST = Forward Instability Shock Test
4. BIST = Backward Instability Shock Test

## Table 08. (page 2 of 4)
## Screening Outline for Diodes

| Part Category \ Test Sequence | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|
| | Post Reverse Bias Burn-In Electrical Measurements | Power Burn-In | Post Power Burn-In Electrical Measurements | Final Electrical Parameter Measurements | Seal Leak Tests | Radiography | External Visual Examination |
| a. Diodes, Small Signal, Silicon | None | MIL-STD-750 Method 1038 Test Condition B. 168 hours at specified $v_r$ and $I_O$ with f = 60 Hz. | Remeasure $V_F$ and $I_R$. Record Values and reject devices that exceed their specified limits. In addition reject diodes exceeding the following delta ($\Delta$) change: $\Delta V_F = \pm 2.5\%$, $\Delta I_R$ = 100% or a number value determined for each diode part type, whichever is greater. | All electrical parameters of each device shall be measured as listed on the manufacturer's data sheet. | MIL-STD-750 Method 1071.1. Fine Leak: Test Condition G or H. Gross Leak Test Condition C.<br>Only for Grade 1 screening | MIL-STD-750 Method 2076<br>Only for Grade 1 screening | MIL-STD-750 Method 2071<br>Only for Grade 1 screening |
| b. Diodes, Switching Silicon | Remeasure $V_F$ and $I_R$. Delta ($\Delta$) reject criteria for $V_F$ and $I_R$ are to be determined individual diode type. | | | | | | |
| c. Diodes, Voltage Reference, Silicon | Remeasure BV and Z. Reject devices that exceed specified limits or exceed the following delta limits:<br>$\Delta Z = \pm 10\%$<br>$\Delta BV$ = appropriate value determined for each part type. | None | None | | | | |
| d. Diodes, Voltage Regulator, Silicon | Remeasure BV, $I_R$ and Z. Reject devices that exceed specified limits or exceed the following delta limits:<br>$\Delta BV = \pm 2\%$<br>$\Delta Z = 10\%$<br>$\Delta I_R$ = 100% or a number value determined for each part type, whichever is greater. | | | | | | |
| e. Diodes, Power Rectifiers, Silicon (Fast Recovery or General Purpose) | None | 168 hours at $T_A = 25^\circ C$ for diodes with leads or $T_C = 100^\circ C$ (For stud mfg) with 60 Hz waveform applied to diode. During the half cycle when the diode is fwd biased, $I_O$ = max rated value. During reversed bias half cycle, $v_r$ = max rated value. | Remeasure $v_f$ and $I_R$. Follow above procedure a. and b. and use following delta changes: $\Delta v_f = \pm 9.1v$ (pk) and $\Delta I_R$ = 100% or a number value determined for each part type, whichever is greater. | | | | |

## Table 08. (page 3 of 4)
## Screening Outline for Diodes[1]

| Part Category \ Test Sequence | 1<br>Internal Visual (Precap) Inspection | 2<br>Initial Insp. & Electrical Parameter Measurements | 3<br>High Temperature Storage | 4<br>Thermal Shock (Temperature Cycling) | 5<br>Acceleration | 6<br>PIND[2] | 7<br>FIST[3] | 8<br>BIST[4] | 9<br>Seal Leak Tests | 10<br>Pre-Power and Reverse Bias Burn-In Electrical Measurements | 11<br>Reverse Bias Burn-In |
|---|---|---|---|---|---|---|---|---|---|---|---|
| g. Diodes, Voltage-Variable Capacitor, Silicon | MIL-STD-750 Method 2074. (Since this test can only be performed by the manufacturer, specify internal visual inspection in procurement document.) | Visual insp. per MIL-STD-750 Method 2071.<br><br>Measure all electrical parameters. | All devices shall be stored for 48 hrs at $T_A = 200^{\circ}C$. (If leads are tinned or made of silver, the heating must be in an inert atmosphere or reduce temperature to $T_A = 125^{\circ}C$. | MIL-STD-750 Method 1051 (Refers to MIL-STD-202 Method 107 for procedural details). Test Condition C, except 10 cycles total with 15 minutes rest at each temperature extreme. | MIL-STD-750 Method 2006 except test shall be 20,000g in $Y_1$ orientation only, one time only. | MIL-STD-750 Method 2052 | MIL-STD-750 Method 2081 | MIL-STD-750 Method 282 | | Serialize devices Measure $I_R$. Record values and reject all devices that exceed their specified limits. | MIL-STD-750 Method 1038 Test Cond. A 72 hrs at $T_A = 175^{\circ}C$. Note: at end of test $V_R$ remains applied until $T_A = 30^{\circ}C$. |
| h. Thyristors, (Silicon Controlled Rectifiers) | | | Same as above except $T_A = 150^{\circ}C$ | Same as above except Test Condition F. | Same as above except stress level to be determined by part size. | Only for Grade 1 screening | Only for Grade 1 screening | Only for Grade 1 screening | MIL-STD-750, Method 1071.1. Fine Leak: Test Condition G or H. Gross Leak: Test Condition C.<br><br>Only for Grade 2 screening | Same as above except measure $I_{RBXM}$, $I_{FBXM}$, $V_F$, $V_{GT}$, and $I_{GT}$. | Same as above except 96 hrs at $T_A = 125^{\circ}C$ with $R_{OR}$ and $V_{FBXM}$ at rated values. Note: Thyristors which turn on during this burn-in shall be rejected. |
| i. Diodes, Current Regulator, Silicon | | | Same as above except $T_A = 175^{\circ}C$ | Same as above except high temperature = $125^{\circ}C$ | Same as Part Category g. above. | | | | | Same as above except measure $I_R$ only. | None |
| j. Diodes, Switching, Schottky Barrier, Silicon | | | Same as above except $T_A = 200^{\circ}C$ | Same as Part Category g. above. | | | | | | Same as above except measure $I_R$ and VB only | |
| k. Diodes, Switching, PIN | | | Same as above except $T_A = 150^{\circ}C$ | Same as Part Category g. above except Test Condition F. | | | | | | Same as above except measure $I_R$ and VB only. | |
| l. Diodes, Light Emitting | | | Same as above except $T_A$ limited to manufacturer's specified maximum storage temperature. | Same as above except temperature extremes limited to manufacturer's specified minimum and maximum storage temperature. | Same as above except acceleration in $Z_1$ direction. | | | | MIL-STD-750 Method 1071 Fine Leak: Test Condition H. Gross Leak: Test Condition E. Only for Grade 2 screening. | Measure and record values for $V_F$ and $P_O$ (Radiant Power Output). Reject devices not meeting specifications. | |

Notes:

1. For complete procurement requirements, consult your project parts engineer.
2. PIND = Particle Impact Noise Detection
3. FIST = Forward Instability Shock Test
4. BIST = Backward Instability Shock Test

# Table 08. (page 4 of 4)
## Screening Outline for Diodes

| Part Category \ Test Sequence | 12<br>Post Reverse Bias Burn-In Electrical Measurements | 13<br>Power Burn-In | 14<br>Post Power Burn-In Electrical Measurements | 15<br>Final Electrical Parameter Measurements | 16<br>Seal Leak Tests | 17<br>Radiograph | 18<br>External Visual Examination |
|---|---|---|---|---|---|---|---|
| g. Diodes, Voltage-Variable Capacitor, Silicon | Remeasure $I_R$. Reject devices that exceed specified limits or exceed the following delta limits: $\Delta I_R$ = 100% or a number value determined for each part type, whichever is greater. | None | None | Visual Inspection per MIL-STD-750 Method 2071.<br><br>All electrical parameters of each device shall be measured as listed on the manufacturer's data sheet. | MIL-STD-750, Method 1071.1 Fine Leak Test Condition G or H, Gross Leak Test Condition C.<br><br>Only for Grade 1 screening. | MIL-STD-750 Method 2076<br><br>Only for Grade 1 screening. | MIL-STD-750 Method 2071<br><br>Only for Grade 1 screening. |
| h. Thyristors, (Silicon Controlled Rectifiers) | Remeasure $I_{RBXM}$, $I_{FBXM}$, $V_{GT}$ and $I_{GT}$. Follow procedure above and use the following delta changes.<br>$\Delta I_{RBXM}$ = appropriate value<br>$\Delta I_{FBXM}$ = appropriate value | | | | | | |
| i. Diodes, Current Regulator, Silicon | None | 168 hours at $T_A$ = 25°C and $P_{OV}$ (Peak Operating Voltage) = maximum rated value. | Remeasure $I_P$. Reject devices that exceed specified limits or exceed the following delta limits.<br>$\Delta I_P$ = +5% | | | | |
| j. Diodes, Switching, Schottky Barrier, Silicon | | MIL-STD-750 Method 1038 Test Condition B, 168 hours at $T_A$ = 25°C at specified $V_r$ and $I_o$ with f = 60 Hz. | Remeasure VB and $I_R$. Reject devices that exceed limits or exceed the following delta limits.<br>VVB = 10%<br>$\Delta I_R$ = 100% or a number value determined for each part type, whichever is greater. | | | | |
| k. Diodes Switching, PIN | | | Remeasure $V_F$ and $I_R$. Reject devices that exceed specified limits or exceed the following delta limits.<br>$\Delta V_F$ = ±10%<br>$\Delta I_R$ = same as $\Delta I_R$ above. | | MIL-STD-750 Method 1071 Fine Leak Test Condition H Gross Leak Test Condition E only for Grade 1 screening. | | |
| l. Diode, Light Emitting | | 168 hours at $T_A$ (or $T_C$) = 25°C<br>$I_F$ = 80% of maximum rated continuous forward current. | Remeasure $V_F$ and $P_O$. Reject devices not meeting specifications or exceeding the following delta limits:<br>$\Delta V_F$ = ±2.5%<br>$\Delta P_O$ = -2.5% | | | | |

# Table 09. (page 1 of 4)
## Screening Outline for Transistors[1]

| Test Sequence / Part Category | 1<br>Internal Visual (Precap) Inspection | 2<br>Initial Inspection & Electrical Parameter Measurements | 3<br>High Temperature Storage | 4<br>Thermal Shock (Temperature Cycling) | 5<br>Acceleration | 6<br>PIND[2] | 7<br>FIST[3] | 8<br>BIST[4] | 9<br>Seal Leak Tests |
|---|---|---|---|---|---|---|---|---|---|
| a. Transistors, Silicon, NPN, Low, Medium Power, Switching or General Purpose | MIL-STD-750 Method 2072. (Since this test can only be performed by the manufacturer, specify internal visual inspection in procurement document.) | Visual Inspection per MIL-STD-750, Method 2071.<br><br>Measure all electrical parameters. | Store for 48 hours at $T_A = 200°C$. (If lead are silver or tinned the heating must be in an inert atmosphere or reduce temperature to $T_A = 125°C$). | MIL-STD-750 Method 1051. (Refer user to MIL-STD-202 Method 107 for procedural details). Test Condition C, except 10 cycles total with 15 minutes rest at each temperature extreme. | MIL-STD-750 Method 2006 except that test shall be 20,000 g on $Y_1$ orientation, one time only. The 1 min hold-time requirement shall not apply. | MIL-STD-750 Method 2052<br><br>Only for Grade 1 screening | MIL-STD-750 Method 2081<br><br>Only for Grade 1 screening | MIL-STD-750 Method 2082<br><br>Only for Grade 1 screening | MIL-STD-750 Method 1071.1 Fine Leak: Test Condition G or H. Gross Leak: Test Condition C. Only for Grade 2 screening |
| b. Transistors, Silicon, PNP, Low, Medium Power, Switching or General Purpose | | | | | | | | | |
| c. Transistors, Silicon, PNP, High Power | | | | | Same as above except 5,000 g. | | | | Same as above except fine leak rejection value of $5 \times 10^{-7}$ atm cc/sec. Only for Grade 2 screening |
| d. Transistors, Silicon, NPN, High Power | | | | | | | | | |
| e. Transistors, Field-Effect, Junction, N-Channel, Silicon | | | | | Same as above except 20,000 g. | | | | MIL-STD-750 Method 1071.1 Fine Leak: Test Condition G or H Gross Leak: Test Condition C. Only for Grade 2 screening |
| f. Transistors, Field-Effect, Junction, P-Channel, Silicon | | | | | | | | | |

Notes:

1. For complete procurement requirements, consult your project parts engineer.
2. PIND = Particle Impact Noise Detection
3. FIST = Forward Instability Shock Test
4. BIST = Backward Instability Shock Test

## Table C9. (page 2 of 4)
## Screening Outline for Transistors

| Test Sequence / Part Category | 10<br>Reverse Bias Burn-In | 11<br>Pre-Burn-In Electrical Measurements | 12<br>Burn-In | 13<br>Post Burn-In Tests | 14<br>Final Electrical Parameter Measurements | 15<br>Seal Leak Tests | 16<br>Radiography | 17<br>External Visual Examination |
|---|---|---|---|---|---|---|---|---|
| a. Transistors, Silicon, NPN, Low, Medium Power, Switching or General Purpose | 48 Hours at: $V_{CB}$ = 80% of $V_{CBO}$, $I_E$ = 0, $T_A$ = 150°C. Reduce temperature to $T_A$ = 30°C before reverse voltage is removed at end of test. Measure $I_{CBO}$ and reject devices that exceed their specified limits. | Measure $I_{CBO}$ (or $I_{CES}$) and $h_{FE}$. Record values and reject all devices that exceed limits. ($I_{CES}$ is measured when value for $I_{CBO}$ is not specified.) | 168 hrs at $T_A$ = 25°C at specified $V_{CB}$ (or $V_{CE}$) and $P_T$ (max rated power dissipation at $T_A$). | Remeasure values of $I_{CBO}$ and $h_{FE}$. Record values and reject devices that exceed their specified limits. In addition reject devices exceeding the following delta ($\Delta$) change during the burn-in: $\Delta h_{FE}$ = ±15%, $\Delta I_{CBO}$ = 100% or 5nAdc, whichever is greater. (It should be noted that the 5nA value varies from part to part in the $\Delta I_{CBO}$ rejection criteria. This number value is for the purpose of not rejecting devices which have very low initial leakage current ($I_{CBO}$) which can vary more than 100% during burn-in.) | All electrical parameters of each device shall be measured as listed on the manufacturer's data sheets. | MIL-STD-750 Method 1071.1. Fine Leak: Test Condition G or H Gross Leak: Test Condition C.<br><br>Only for Grade 1 screening | MIL-STD-750 Method 2076<br><br>Only for Grade 1 screening | MIL-STD-750 Method 2071<br><br>Only for Grade 1 screening |
| b. Transistors, Silicon, PNP, Low, Medium Power, Switching or General Purpose Purpose | | | | | | | | |
| c. Transistors, Silicon, PNP, High Power | | | Same as above except $P_T$ at case temperature specified. | | | Same as above except fine leak rejection value 5 x $10^{-7}$ atm cc/sec. Only for Grade 1 screening | | |
| d. Transistors, Silicon, NPN, High Power | | | | | | | | |
| e. Transistors, Field-Effect, Junction, N-Channel, Silicon | N.A. | Measure $I_{GSS}$, $I_{DSS}$ and $\lvert Y_{fs} \rvert$. Reject all devices that exceed limits. | 168 hrs at $T_A$ = 175°C at specified $V_{GS}$ and $V_{DS}$. Reduce $T_A$ below 30°C, hold for 10 min before removing voltage. (This is a high temperature reverse bias burn-in.) | Remeasure values of $I_{GSS}$, $I_{DSS}$ and $\lvert Y_{fs} \rvert$. Record values and reject devices that exceed their specified limits. In addition reject devices exceeding the following delta ($\Delta$) change during the burn-in: $\Delta I_{DSS}$ = ±10%, $\Delta \lvert Y_{fs} \rvert$ = ±20% and $\Delta I_{GSS}$ = 100% or a number value determined for each part type, whichever is greater. Note: If the max rated $I_{GSS}$ is less than 100pA, omit $\Delta I_{GSS}$ criteria. | | MIL-STD-750 Method 107.1. Fine Leak: Test Condition G or H Gross Leak: Test Condition C. Only for Grade 1 screening | | |
| f. Transistors, Field-Effect, Junction, P-Channel, Silicon | | | | | | | | |

## Table 09. (page 3 of 4)
## Screening Outline for Transistors[1]

| Part Category \ Test Sequence | 1<br>Internal Visual (Precap) Inspection | 2<br>Initial Inspection & Electrical Parameter Measurements | 3<br>High Temperature Storage | 4<br>Thermal Shock (Temperature Cycling) | 5<br>Acceleration | 6<br>PIND[2] | 7<br>FIST[3] | 8<br>BIST[4] | 9<br>Seal Leak Tests |
|---|---|---|---|---|---|---|---|---|---|
| g. Transistors, Silicon, Unijunction | MIL-STD-750 Method 2072. (Since this test can only be performed by the manufacturer, specify internal visual inspection in procurement document.) | Visual Inspection per MIL-STD-750 Method 2071.<br><br>Radiographic Inspection per MIL-STD-750, Method 2076.<br><br>Measure all electrical parameters at this time. | Store for 48 hours at $T_A$ = 200°C. (If leads are silver or tinned the heating must be in an inert atmosphere or reduce temperature to $T_A$ = 125°C | MIL-STD-750 Method 1051. (Refers user to MIL-STD-202 Method 107 for procedural details.) Test Conditions C, except 10 cycles total with 15 minutes rest at each temperature extreme. | MIL-STD-750 Method 2006 except that test shall be 20,000 g in $Y_1$ orientation, one time only. The 1 min. hold-time requirement shall not apply. | MIL-STD-750 Method 2052<br><br>Only for Grade 1 screening | MIL-STD-750 Method 2081<br><br>Only for Grade 1 screening | MIL-STD-750 Method 2082<br><br>Only for Grade 1 screening | MIL-STD-750 Method 1071.1. Fine Leak: Test Condition G or H Gross Leak: Test Condition C. Only for Grade 2 screening. |
| h. Transistors, Silicon, Chopper | | | | | | | | | |
| i. Phototransistor | | | Same as above except $T_A$ shall be limited to manufacturer's specified maximum storage temperature. | Same as above except temperature extremes shall be limited to manufacturer's specified minimum and maximum storage temperature. | | | | | MIL-STD-750 Method 1071. Fine Leak: Test Condition H. Gross Leak: Test Condition K. Only for Grade 2 Screening |
| j. Optically Coupled Isolator | | | | | | | | | MIL-STD-750 Method 1071.1. Fine Leak: Test Condition G or H Gross Leak: Test Condition C. Only for Grade 2 Screening |

Notes:

1. For complete procurement requirements, consult your project parts engineer.
2. PIND = Particle Impact Noise Detection
3. FIST = Forward Instability Shock Test
4. BIST = Backward Instability Shock Test

# Table 09. (page 4 of 4)
## Screening Outline for Transistors

| Part Category \ Test Sequence | 10<br>Reverse Bias Burn-In | 11<br>Pre Burn-In Electrical Measurements | 12<br>Burn-In | 13<br>Post-Burn-In Electrical Measurements | 14<br>Final Electrical Parameter Measurements | 15<br>Seal Leak Tests | 16<br>Radiography | 17<br>External Visual Examination |
|---|---|---|---|---|---|---|---|---|
| g. Transistors, Silicon, Unijunction | 168 hrs at $T_A = 175^\circ C$ at specified $V_{GS}$ and $V_{DS}$. Reduce $T_A$ below 30°C. hold for 10 min before removing voltage. | Measure $I_{EB20}$, $R_{BBO}$ and $\eta$. Record values and reject all devices that exceed limits. | 168 hrs at $T_A = 25^\circ C$ at specified $V_{B2B1}$ and $I_{E1}$. (Maximum rated power.) | Remeasure values of $I_{EB20}$, $R_{BBO}$ and $\eta$. Record values and reject devices that exceed their specified limits. In addition reject devices exceeding the following delta ($\Delta$) change during the burn-in: $\Delta\eta = \pm 10\%$, $\Delta R_{BBO} = \pm 20\%$ and $\Delta I_{EB20} = 100\%$ or 5 nA, whichever is greater. | All electrical parameters of each device shall be measured as listed on the manufacturer's data sheets. | | MIL-STD-750 Method 2026<br>Only for Grade 1 screening | MIL-STD-750 Method 2072<br>Only for Grade 1 screening |
| h. Transistors, Silicon, Chopper | 48 hrs at:<br>$V_{CB}$ = 80% of $V_{CBO}$<br>$I_E = 0$, $T_A = 150^\circ C$<br>Reduce temperature to $T_A = 30^\circ C$ before reverse voltage is removed at end of test. Measure $I_{CBO}$ and reject devices that exceed their specified limits. | Measure $I_{CBO}$ and $h_{FE}$ (inverted). Record values and reject all devices that exceed limits. | 168 hrs at $T_A = 25^\circ C$ at specified $V_{CB}$ (or $V_{CE}$) and $P_T$. (Max rated power dissipation at $T_A$). | Remeasure values of $I_{CBO}$ and $h_{FE}$ (inverted). Record values and reject devices that exceed their specified limits. In addition reject devices exceeding the following delta ($\Delta$) change during the burn-in: $\Delta h_{FE}$ (inverted) = ±15%, $\Delta I_{CBO}$ = 100% or 5 nAdc, whichever is greater. (It should be noted that the 5 nA value varies from part to part in the $\Delta I_{CBO}$ rejection criteria. This number value is for the purpose of not rejecting devices which have very low initial leakage current ($I_{CBO}$) which can vary more than 100% during burn-in.) | | MIL-STD-750 Method 1071.1. Fine Leak: Test Condition G or H. Gross Leak: Test Condition C.<br>Only for Grade 1 screening | | |
| i. Phototransistor | 48 hrs at:<br>$V_{CE}$ = 80% of $V_{CEO}$<br>$E_e$ (Incident Radiant Energy = 0)<br>$T_A$ (or $T_C$) = manufacturer's specified maximum operating temperature.<br>Measure $I_D$ (Dark Current) and reject devices exceeding specified limits. | Measure $I_D$ and $I_L$. Record values and reject all devices that exceed specified limits. | 168 hrs at $T_A$ (or $T_C$) = 25°C at specified $V_{CE}$. Adjust $E_e$ (incident radiant energy) for $P_T$ = 80% of maximum continuous device dissipation at $T_A$ (or $T_C$) = 25°C | Remeasure values of $I_D$ and $I_L$. Reject devices that exceed specified limits or exceed the following delta limits:<br>$\Delta I_L = \pm 25\%$<br>$\Delta I_D$ = 100% or an absolute value determined for each part type, whichever is greater. | | MIL-STD-750 Method 1071 Fine Leak: Test Condition H. Gross Leak: Test Condition K.<br>Only for Grade 1 screening | | |
| j. Optically Coupled Isolator | MIL-STD-750 Method 1019 Test Condition A.<br>$V_{CE}$ = 80% of $V_{CEO}$<br>$T_A$ (or $T_C$) = 125°C or maximum specified operating temperature, whichever is lower. (Do not bias LED during this test.)<br>Measure $I_C$ (OFF) within 4 hours of test completion. Reject devices that exceed specified limits. | Measure the following parameters<br>Phototransistor<br>$I_C$ (OFF)<br>$I_C$ (ON)<br>$h_{FE}$<br>LED<br>$I_R$<br>Record values and reject devices that exceed specified limits. | 168 hrs at $T_A$ (or $T_C$) = 25°C at specified $V_{CE}$. Select an LED forward current ($I_F$) for a phototransistor power dissipation of $P_T$ = 80% of maximum continous device dissipation at $T_A$ (or $T_C$) = 25°C. | Remeasure $I_C$ (OFF), $I_C$ (ON), $h_{FE}$, and $I_R$. Reject devices that exceed specified limits or exceed the following delta limits:<br>Phototransistor<br>$\Delta I_C$ (ON) = ±25%<br>$\Delta h_{FE}$ = ±25%<br>$\Delta I_C$(OFF)= 100% or a number value determined for each part type, whichever is greater.<br>Ligh Emitting Diode<br>$\Delta I_R$ = 100% or an absolute value determined for each part type, whichever is greater. | | MIL-STD-750 Method 1071.1 Fine Leak: Test Condition G or H. Gross Leak: Test Condition C.<br>Only for Grade 1 screening | | |

# Table 10.
# Screening Outline for Microcircuits[1]

Two levels of screening are outlined for microcircuits. Level 1 screening is required for all non-standard parts intended for use in a grade 1 application. Level 2 screening is required for non-standard parts intended for other than grade 1 applications.

| Screening Sequence / Screening Level | 1 | 2[2] | 3 | 4[3] | 5 | 6[4] | 7[5] | 8[6,7] |
|---|---|---|---|---|---|---|---|---|
| | Internal Visual (Precap) Can only be performed by mfr. Specify requirement | Stabilization Bake | Temperature Cycling | Constant Acceleration | Particle Impact Noise Detection (PIND) | Seal | Interim Electrical Parameter Measurements | Burn-In |
| 1 | MIL-STD-883 Method 2010 Condition A | MIL-STD-883 Method 1008 Condition C | MIL-STD-883 Method 1010 Condition C | MIL-STD-883 Method 2001 Condition E. Y Orientation only. | MIL-STD-883 Method 2020 Condition A or B. Specify test condition | MIL-STD-883 Method 1014 Fine Leak: Cond. A or B. Gross Leak Cond. C. Specify test conditions | Specify DC & AC parameters and parameters requiring delta calculations | MIL-STD-883 Method 1015 240 hrs at 125°C (Dynamic) Specify test cond. and burn-in circuitry |
| 2 | Same as above except Condition B | Same as above | Same as above | Same as above | Not Required | Same as above | Measure parameters requiring delta calculations | Same as above except 160 hrs. at 125°C See note 6 |

| Screening Sequence / Screening Level | 9 | 10[6] | 11[5] | 12[4] | 13 |
|---|---|---|---|---|---|
| | Interim Electrical Parameter Measurements | Reverse Bias Burn-In | Final Electrical Measurements | Radiographic | External Visual |
| 1 | Remeasure parameters specified in step 7. Specify delta limits and percent defective allowable. (PDA) | MIL-STD-883 Method 1015 Condition A or C. 72 hrs at 150°C Specify test cond. & burn-in circuitry. | Specify DC, AC and delta measurements at 25°C, min. and max. operating temperatures. | MIL-STD-883 Method 2012 | MIL-STD-883 Method 2009 |
| 2 | Not Required | Not Required | Same as above | Not Required | Same as above |

NOTES:
1. For complete procurement requirements, consult your project parts engineer.
2. User should be aware of tarnish problems of some lead finishes at temperatures above 150°C.
3. For microcircuit packages having an inner seal or cavity perimeter greater than 2 inches, or a mass greater than 5 grams, refer to MIL-STD-883B, Method 5004, paragraph 3.2 for acceleration instructions.
4. Seal and radiographic tests may be performed in any sequence after PIND test.
5. The parameter measurements and delta calculations required for both level 1 and level 2 screening shall include those parameters and deltas (including measurements for each test condition for each parameter) specified in the MIL-M-38510 slash sheet for the selected part. If no slash sheet is available for the selected part, model the parameter and delta requirements from a slash sheet for a similar part type. If no slash sheet is available for selected or similar part types, consult the project parts engineer for recommendations.
6. For level 1 screening, the order of the burn-in in step 8 and step 10 is optional.
7. For level 2 screening, SSI and MSI MOS devices shall be exposed to both dynamic (160 hrs at 125°C) and static (160 hrs at 125°C, or optionally 24 hrs at 150°C) burn-ins in screening step 8. The order of the burn-ins is optional. For other technologies, use the burn-in method specified for Class B screening in the MIL-M-38510 slash sheet for the selected or similar part types. If no slash sheets are available for the selected or similar part types, consult the project parts engineer for recommendations.

## Table 14.
## Screening Outline for Thermistors[1]

| Test Sequence / Category | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| | External Visual Examination | Initial Measurements | Bake | Temperature Cycle | Burn-In | Final Measurements and Tests | External Visual Examination |
| (a) Thermistors, (Thermally Sensitive Registor) (Negative Temp. Coef.) | MIL-T-23648 Paragraph 4.6.1 | Zero-Power Resistance at 25°C and IR | 100 hrs at Maximum Specified Operating Temperature | MIL-STD-202 Method 107 Cond. B | Not Required | Zero-Power Resistance at 25°C | MIL-T-23648 Paragraph 4.6.1 |
| (b) Thermistors, Fixed Silicon (Positive Temp. Coef.) | | Zero-Power Resistance at 25°C | Not Required | | 1.5 x rated pwr. for 96 hrs at 25°C | | |

NOTE:
1. For complete procurement requirements, consult your Project Parts Engineer.

## Table 15.
## Screening Outline for Transformers[1]

| Test Sequence / Category | 1<br>Initial Measurements | 2<br>Thermal Shock | 3<br>Burn-In | 4<br>Seal Leak Test | 5<br>Final Measurements and Tests | Reference Documents |
|---|---|---|---|---|---|---|
| Transformers, Audio and Power | 1. Visual Examination<br>2. Dielectric Withstanding Voltage (DWV)<br>3. Induced Voltage<br>4. Insulation Resistance (IR)<br>5. D.C. Resistance (DCR) of each winding<br>6. Primary Inductance (L)<br>7. Turns Ratio | MIL-STD-202, Method 107, Test Condition A-1. Use maximum temperature specified for transformer as maximum temperature. | Not Required | Do not perform these tests on encapsulated units. MIL-STD-202, Method 112. Test Condition C for Fine Leak. Test Condition D for Gross Leak. Use maximum temperature specified for transformer as bath temperature. | Repeat initial examinations and measurements. Reject criteria:<br>$\Delta L > \pm 3\%$ (powder core and toroids)<br>$\Delta DCR > \pm 3\%$<br>DWV < min. specified<br>IR < min. specified<br>Turns ratio must equal specified value. | MIL-T-27<br>MIL-STD-202 |
| Transformers, Pulse, Low Power | 1. Visual Examination<br>2. Dielectric Withstanding Voltage (DWV)<br>3. Induced Voltage<br>4. Insulation Resistance (IR)<br>5. DC Resistance (DCR)<br>6. Open Circuit Inductance (OCL)<br>7. Leakage Inductance<br>8. Turns Ratio | Not Required | MIL-T-21038 Para. 4.7.4 | MIL-T-21038 Para. 4.7.7 (Gross Leak Test) | Repeat initial measurements and examinations. Measure turns ratio and waveform (rise time, overshoot, droop, backswing, decay time). Reject criteria:<br>$\Delta DCR < \pm 3\%$,<br>DWV < min. specified,<br>IR < min. specified.<br>Turns ratio must equal specified value. Waveform parameters must not exceed the specified maximums. | MIL-T-21038 |

NOTE:
1. For complete procurement requirements, consult your Project Parts Engineer.